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EDITORIAL NOTES—GAS, &c.

Betterment at the Gaslight and Coke Company.

AFTER the somewhat gloomy successive financial statements that preceded 1906, the proprietors of the Gaslight and Coke Company received with marked satisfaction the greatly improved condition of affairs that the trading of the first half of last year enabled the Governor (Mr. Corbet Woodall) and his colleagues to present to them. This satisfaction will be further enlivened by the report and accounts that have been issued for the past half year. True, the better financial condition has been helped by kindly-disposed markets for coke and tar products, and by an increased consumption of gas; but those favourable aids alone are not sufficient to account for the healthier condition of the half-year's accounts when compared with those for the corresponding period of 1905. Administration can take credit for a considerable proportion of the balance of the improvement. A year ago, the proprietors heard from Mr. Woodall (who was at the time Acting Governor) of embryonic economies; in the revenue account before us, these economies have developed into substance. The final result is that, after setting aside £10,000 to the redemption fund, and transferring £2500 to the insurance fund, there is a balance of £353,940, as against £298,801 in the corresponding period of the preceding year, or a gain of £55,139. The amount brought forward was £210,481; so that the total sum available for distribution is £564,421, compared with £516,209. Paying the same dividend of £4 8s. per cent., the carry-forward will be £229,953, as against £181,298.

These are the whole figures that, as a rule, serve solely in the eyes of the lay proprietors as the index of prosperity and good management, or contrariwise. To stop at whole figures, however, does not enable any apportionment of credit, or otherwise, to be made as between fortuitous conditions, active enterprise, and economical management. The revenue account is worthy of study from these standpoints, for it distinctly discloses improvement as the effect of the operations of both external and internal energy. The fortuitous conditions (of course, supplemented by circumspect dealings) are reflected in the residuals accounts; the active enterprise, in the increased gas sales and connections; and the economical management, in the expenditure, without in the slightest sacrificing efficiency in plant or service. Examining first, in the usual order, the items on the receipts side of the account, the income from gas amounted to £1,512,275, or an increase of £8353. The percentage increase in the sale of gas was 1·1; but, in volume, the increase was 116,396,000 cubic feet—the total sale being 10,683,924,000 cubic feet. It must be remembered that the Company did an exceptionally good gas business in the first half of the year—the increase registered being equal to nearly 4 per cent.; so that the augmentation of the 1905 consumption in 1906 was equal to 2½ per cent. Given favourable conditions, there are excellent grounds for anticipating a continuation of this forward movement in business; for we hold that expansion in the numbers of consumers on the books of a gas company is a weightier element among the considerations affecting judgment as to the future than current percentage increases or decreases, which are subjected to so many disturbing factors of Nature's making. In the present report of the Directors, it is found that the number of consumers has been supplemented by 16,693, which, added to the number enrolled in the first half of the year, gives a further solid business backing of 30,105, compared with the position at the opening of the year. That is not all. There were 20,875 stoves coupled up during the half year, and 14,379 in the first half; so here again there are 35,254 new outlets for consumption. The rental-yield of stoves advanced by about £2000 compared with the corresponding period of last year; and the item is bound to present a further advance.

Turning to the residuals department, the prediction the Governor made six months ago, that coke sales during the half year would show an improvement, has been justified by the event; and tar and its products have also contributed to the increased income. But the figures in the revenue account do not, in their totals, present to view the whole of the higher value that coke and tar products have commanded. We must make comparison with the later statement as to residuals to see the full effect, for the greater returns have been obtained on a somewhat lessened sale, and presumably demand, in comparison with the latter half of 1905. Coke produced £218,187, which was an increase of £14,987; but the quantity of coke sold was less by 44,750 tons, and the quantity used on the works also showed a decline of about 6000 tons. Breeze, however, is short of the corresponding half-year's receipts by about £2000; and the quantity sold was 18,121 tons less. The income from tar and tar products was £48,487, or £8081 more. The quantity of tar used was 70,376 gallons less; but seeing that the total dealt with in a half year runs close up to 8 million gallons, variations of a few tens of thousands can hardly be wondered at. The receipts from ammoniacal liquor and sulphate amount to £80,026, which is a decline of rather more than £1000. In the quantitative statement as to residuals, it is seen that 6191 butts less liquor were used. However, the receipts from residuals amounted in the whole to £358,795, which was an improvement of close upon £20,000.

It is in connection with the expenditure side of the revenue account that there are exhibited material economies and advances in working excellence, without impairing in any way the efficiency of plant by any retrograde movement in upkeep. As a matter of fact, while something like £2000 less has been spent on the repair and maintenance of works, nearly £21,000 more has been expended in the distribution department on repairs, maintenance, and renewals. Therefore we must look elsewhere for the savings that have produced the reduction of £37,525 in the total expenditure, on comparison with the same period of 1905. The total disbursement for coal, oil, coke, and breeze used in manufacture, was £599,655, or £1391 more than in the corresponding half year. Examining the individual items, it is seen that only £5384 more was spent on coal; but, as will be shown, the tonnage used was less than in the period with which comparison is made. At the same time, it is gratifying that the item itself does not wear a worse aspect, remembering the views of coal owners in the early part of the year. Oil, on the other hand, exhibits a decrease of £7524; but coke and breeze has increased by £3530. Grouping these materials, the variation of only £1391 on the total cost is most satisfactory, considering the large addition of upwards of 116 million cubic feet to the gas sales; but it does not convey to the full the credit due to the working in the Company's chief technical department. The greater output of gas has been produced from a considerably smaller quantity of raw material. The quantity of coal used was reduced by 26,616 tons; the oil and spirit by nearly 858,064 gallons; and the coke by 6021 tons. It can therefore easily be seen what a substantial additional charge would have appeared in the revenue account if the yields of the materials used in the carbonizing department had remained at former levels. The technical staff are to be congratulated. There again the whole tale is not told; for this greater efficiency is accompanied by a reduction of £21,670 in manufacturing salaries and wages—the total for the half year being £119,870. Purification costs have also been reduced by £14,334; and on the year by nearly £26,000. The accounts are thus benefiting from the removal of the old statutory excesses in this connection. The effects of the quinquennial revision of the assessment of the Company's property which was completed twelve months ago (when some reductions were secured amounting to over £48,000) is seen in these accounts; for the £136,742 for rates and taxes in the half year is £12,082 less than for the corresponding

period. There are differences in other items of the revenue account, but they are of minor importance.

We have shown in this review of the accounts that the financial improvement revealed is due not only to increased business and better selling markets, but to retrenchment and reform—wisely and well ordered. Great things in this way cannot be accomplished in a day; but there are here substantial evidences of a prompt and successful attack.

Electrified Photometry.

Some information and much amusement have been afforded to gas men by the proceedings at the meeting of the Institution of Electrical Engineers on Thursday last. Mr. C. C. Paterson, an Associate Member of the Institution, essayed to give an account of tests which had been carried out at the National Physical Laboratory at Teddington with reference to "Light Standards and the Present Condition" of the High-Voltage Glow Lamp." The tests, in so far as they related to flame standards, had been undertaken two years ago at the instigation of the Institution of Gas Engineers, and the portion of Mr. Paterson's communication which deals with these standards is reproduced in another part of to-day's "Journal." The courtesy of the Institution of Gas Engineers, in permitting the results of these tests to be published for the first time by Mr. Paterson at a meeting of electricians, was duly acknowledged by him; but the contemptuous remarks on flame standards of some of those who rose to discuss the paper suggest that the courtesy was somewhat misdirected. Moreover, the evident bias of the author of the paper and his *confrères* towards things electrical, leads one to wonder whether the Institution of Gas Engineers had been well advised, in the first instance, in leaving this important investigation in the hands of an electrician. Bearing in mind, however, the limitations of his environment, Mr. Paterson has made a useful report, to portions of which we would more specially call the attention of readers of the "Journal."

Comparisons were made of the Harcourt 10-candle power, the Hefner, and the Carcel standards; and ratios were obtained in fair agreement with those realized at Charlottenburg and elsewhere. To most gas engineers, however, the subject of more immediate interest will be the influence of atmospheric conditions on the values of these flame standards, and of the Harcourt standard in particular. Mr. Paterson pointed out that the principal variations to which the air in a photometer-room is liable are changes of barometric pressure, and in the amounts of (1) carbon dioxide, (2) water vapour, and (3) oxygen and nitrogen. The grouping is noteworthy. The effect of changes in the amount of carbon dioxide was first studied. Normally, the carbon dioxide in the air at Bushy House—presumably in the photometer-room—only varied from 3 to 7 parts per 10,000, according to the somewhat cumbrous and not very precise mode of estimation employed. It is gratifying to know that no difference in candle power of the Harcourt standard could be detected within this range of variation. The amount of carbon dioxide was then artificially increased (by what means we are not informed) to 19 parts per 10,000, the photometer-room being closed, and candle-power readings were taken over four hours. Now, it is obvious that the lamp and the observer or observers—for Mr. Paterson seems to prefer to cumber his photometer-room with an assistant—were producing carbon dioxide and water vapour, and also consuming oxygen, during this period of four hours; and no account appears to have been taken of the diminution of oxygen, while it is not clear whether the artificial increase in the amount of carbon dioxide was not produced solely by the lamp and the observers. Those familiar with the effect of variations in the composition of the atmosphere on flames in general, know well that diminution of oxygen is at least as potent a factor as increase of carbon dioxide; and as Mr. Paterson set about studying the effect of the latter without excluding the former change, his results in this portion of his investigation seem worse than useless. They may refer to the combined effect of increase of carbon dioxide and diminution of oxygen corresponding with the consumption of pentane and the breathing of two persons; but we are not told that this is the case. Until more precise information is forthcoming, therefore, this part of Mr. Paterson's research may be dismissed from notice. It may, however, be permissible to conclude from this and earlier work that, given a properly ventilated photometer-room—*i.e.*, one in which the carbon dioxide will not exceed 8 parts in 10,000—the candle power of the Harcourt lamp will not be affected by slight variations in the composition of the air which are consistent with that criterion of the efficiency of the ventilation.

In regard to the effect of water vapour and of changes in barometric height on the light of the Harcourt standard, Mr. Paterson's present communication adds but little to the summary of researches on these points which was published in the "Journal" for Oct. 2 last (p. 20). With regard to variation in the amount of oxygen, Mr. Paterson hopes to make researches in the future; but his projected scheme of work does not promise more trustworthy results in this direction than those already referred to, which purport to show the effect of increase in the amount of carbon dioxide. As a fact, such investigations should be made in a chemical rather than a physical laboratory, for the mere photometric observations are simple routine work, whereas the determination of the composition of the atmosphere to the degree of accuracy necessary for the attainment of useful results calls for special analytical skill and knowledge.

We propose next week to offer some comments on Mr. Paterson's methods of photometry, and his work on the standardization of electric lamps. For the present, it will suffice to say that his communication presented a record of an immense amount of work, carried out often under unfavourable conditions, and that he is certainly to be heartily congratulated on his diligence and application.

Power Cost and Concomitant Considerations.

The "Engineering Magazine" has commenced a short series of articles, dealing with the choice of power for the workshop, by Mr. R. E. Mathot, whose name is intimately associated with modern work on the gas-engine, and with the literature of the subject. The first of the articles suggests points for consideration, which may be useful at the present time when there appears to be a lull in local and general discussion as to paying and competing prices of gas for power purposes. There has been quite a respectable amount of information published lately on the question of fuel costs for motive power. "Total costs" have also been published; but, from the whole figures (without having the details), it is a matter of exceeding difficulty to learn whether all the general factors contributing to a manufacturer's expenses for power have been conscientiously brought into account. Besides this, there are also factors which have a bearing peculiar to every situation where power is required. Among the rivals, the leading position in regard to heat efficiency, high authorities agree, is held by the gas-engine; but, nevertheless, the gas-engine will not abolish all other forms of power. M. Witz and Mr. Dugald Clerk have both issued warnings against one's enthusiasm being allowed to blind common sense in this matter. The rivals, as M. Witz has pointed out, have their individual advantages and disadvantages; and they will severally continue to find clients. But the gas-engine starts with some advantage as to heat efficiency; and the gas-engine driven by town gas has other advantages which must not be disregarded in the attempt to wrest business from the steam-engine and electricity, to check the progress of suction-gas plant, and to obtain the business that the extensions of manufacturing industries demand. As a rule, those advantages are not taken into account in published "total costs."

Before considering certain of them here, it may be submitted that there is abundant reason for keeping a tight grip upon what is proceeding in this particular line of competition. That there is a great deal of new business to be done is palpable by the marked attention that is being devoted all round to industrial requirements for the lower and medium powers. For the exceptionally large power gas-engines that are to be seen on the Continent, the scope in this country is somewhat limited; and it is not with engines of such colossal type that the gas industry can hope to have direct dealings. It is in the lower and medium power engines that the gas industry has a very deep concern; seeing that Mr. Dugald Clerk is of opinion that already from 15 to 20 per cent. of the gas produced in Great Britain is used for motive power. If due consideration is given to price, and there is proper appreciation of both the strong and the weak points of the competitors, there is no reason why there should not be a large increase in the volume of this business. For notwithstanding the competition of the oldest established of the rivals, steam, and the newer one, electricity, the same eminent authority in the gas-engine

world was saying towards the close of last year that, "at "the present moment, the output of engines exceeds any- "thing before experienced in Great Britain." This is a satisfaction; and it should also be an incentive to seeing that the increased business that is being done in the production and sale of gas-engines has an effect upon the day consumption of gas-works. If it has not any effect, then there must be inquiry as to the direction in which the business is going, and why. The greater number of these engines that are now being turned out are of the lower and medium powers, such as are suitable for manufacturers' workshops. It is with the power requirements of workshops that Mr. Mathot is dealing in his articles; and it is Mr. Dugald Clerk's belief, ripened by long experience and investigation, that the field for the coal-gas engine has its limit at 150-horse power.

That stakes out the power field of the coal-gas industry; and it is in this field that competition is being waged the fiercest between town's gas and suction gas for proportions of the business produced by this larger output of engines as to which authoritative statement has been made. Where suction-gas plants show up favourably is where the price of town's gas is high; but where they cannot compete on level ground is where a gas of respectable thermal value—say, about 600 B.Th.U.—is sold at a low price. In such places, the conditions ought not to require much consideration to persuade an intelligent manufacturer which of the two—the suction-gas plant or the town's gas supply—is the more conducive to his interests. And where the price of town's gas is above the competing level, even then the manufacturer should, before casting his decision, look very intently to the surroundings of the question, and not fix his whole mind upon the central point as to the cost of fuel per B.H.P. that is so persistently and so persuasively urged upon him. In his article, Mr. Mathot submits eight points that the manufacturer should consider. The first is the total power that the manufacturer requires; and we would add to this the question of whether that power is used intermittently or continuously. The second question for consideration is the space needed for the installation. There can be no debating that a gas-engine free from the suction-gas plant appendage requires the least space. The third question is the consumption of combustible, of water, and of oil. Again, there can be no doubt as to the superior working conditions with engines operating on a clean gas of some 600 B.Th.U., compared with the lean variable quality gas drawn by the engine working on a suction-gas plant. The fourth question for the manufacturer's consideration is as to the disposal of waste. There is no waste to dispose of where town's gas is used. The fifth question has a fine comprehensiveness. It embraces local conditions, restrictions imposed by the neighbourhood, legal regulations, requirements, &c. Being without the encumbrance of a suction-gas plant, it follows that in all these respects the engine driven by town's gas has an advantage.

Passing on, Mr. Mathot's sixth question has reference to first cost, interest, and sinking fund. In an article published in the "JOURNAL" on Jan. 8 (p. 86), it was shown that the average price of the winning suction-gas plants and engines in the Derby trials was £11 16s. per declared brake horse power; while the average of the same makers' plants in the Glasgow trials worked out to £9 15s. (of which £4 was the price of the producer) per declared horse power. This looks as though the improvements that have had to be made in the suction plants have rendered it necessary to charge higher prices for them. However, the proportion of cost that the gas plant bears to the engine has an important effect upon the question of initial cost, maintenance, and sinking fund. Question seven is as to the cost of maintenance and upkeep. Seeing that with town gas there are, in addition to the engine, only the coupling-up connections to keep in order, and to put in comparison with the perennial wear and tear that is going on in the suction-gas plant (which does not long continue in its pristine condition), this question of maintenance and upkeep does not admit of much discussion to ascertain whether a gas-engine alone or one *plus* a suction gas plant has the greatest expanding effect on the item. In this connection, it is entertaining to notice that suction-gas people are beginning to openly pull their rivals' plants to pieces. This they have long been doing privately, but not publicly. In the advertisements of one firm, the very pertinent question is asked, "Why does your suction- "gas plant only give half satisfaction?" In the answer to it, it is stated that "if the gas produced were of regular "quality, if clinkers could be avoided or removed without "opening the fire-door, if the fire-bricks could last for five "years, and if the valves of the engines had to be cleaned "only once a month, then your plants would be perfect." That statement may be left to take care of itself. The eighth, and last, question is reliability, regularity, and elasticity of operation. With these essentials in manufacturing operations, the suction-gas plant (without any means of storage upon which to fall back) cannot possibly comply with the delightful freedom of the town gas, with its constancy in supply, practically uniform calorific power, and perpetual availability—without any of the trouble and labour involved by the letting down, cleaning, charging, and banking-up required by suction-gas plant.

The questions alluded to in the foregoing are discussed by Mr. Mathot mainly in relation to the competition of steam plants with the gas-engine; but they come in equally handily in connection with the competition between suction-gas plant and ordinary gas. They are all considerations that may beneficially be laid before the manufacturer inquiring into the questions of the relative advantages of gas-engines run on town's gas and with suction-gas plants; for low cost of output, to quote from the article, "is not the "sole consideration." But it always remains the topmost factor in decision; and therefore the price of gas must needs have the foremost place in the shaping by gas manufacturers of their course of action in the competition. At the Southampton meeting of the Gas Institute a few years ago, Mr. Dugald Clerk put 1s. as the objective of the gas industry in regard to price for power business in competition with other systems; now he puts it at between 1s. and 1s. 6d. Cheap gas, aided by unfulfilled claims for suction-gas plants, has put a check upon the competition; but, by the help of claims based on such refinement of operation and cheap fuel as were disclosed in the Glasgow trials, the suction-gas plant will still make way. The most effectual means of checking the competition—a low-priced supply—must therefore be continued; but the concomitant factors should be kept equally prominent before manufacturers. Valuable aid can be gathered from Mr. Dugald Clerk's lecture at Sheffield, which we printed on Nov. 13 last, from the Derby suction-gas trials referred to in our issue of Dec. 25, and in the comparison of the Glasgow and Derby trial results published on the 8th inst.

Another Insolent Prospectus.

The impudence of the newest cliques of Gas Company promoters has no bounds. The exposure of their doings does not produce any modification of their designs. The latest scheme is for the development of the gas supply of a truly rural district of which Markyate is the centre; and Markyate, according to a report accompanying the prospectus, is four miles from any town known to the generality of people. One of these towns is Luton; and therefore—being some four miles from Luton—the promoters consider that to the public this sufficiently entitles them to offer the Markyate Gas-Works, with the proposed extensions through green lanes to groups of houses rejoicing in the dignity of being called, in this prospectus and report, variously "parishes," "districts," and "villages," under the pretentious designation, of the "South Luton District Gaslight and Coke Company, Limited." These new Gas Company promoters appreciate the attraction value of a name, even though what is behind the name is incorrectly represented by it. All the old tricks of the guarantee of a year's dividend, of calling attention to the remunerative character of incomparable gas undertakings, and of quoting the success of the slot meter and gas cooking-stove in London, are resorted to in this latest invitation to gas investors to sink their money in a proposal about which, craftily, no information is given but what is designedly indefinite and wholly non-committal. There is an imaginative estimate (based on the present price of gas of 5s. 10d.!) which, like the tale in the penny novelette, comes out right in the end. The promoters are asking the public for £30,000 capital, of which, if the public are silly enough to part with their money, £23,350 will be placed at the disposal of the Gas-Works Extension Corporation, Limited, who are the vendors, and who, in their benevolence, have charged no specific sum for goodwill, but who are going (as part of their agreement) to erect an additional "gasometer," retorts, with requisite buildings, &c. Of the £23,350, 20 per cent. is to be paid in cash, and the balance

in cash, or by allotment of fully-paid preference or ordinary shares, at the vendors' option. They also guarantee the first year's dividend, and pay expenses incurred up to the date of allotment. There is another concern mentioned in the prospectus that has a familiar appearance about it—"The Gas and Water-Works Supplies and Construction Company, Limited." But the Gas-Works Extension Corporation, Limited, is a new recruit to these promoting expeditions; for its registration was only announced in the "JOURNAL" for Dec. 11 last, when it was mentioned that the specified capital was £5000, in £1 shares. The ambitions of the "Corporation" are quite in harmony with its title. Our opinion is that the prospects of this concern (considering the notions of the promoters as to capital, and the price to be paid for the works, &c.) are very well illustrated by the crude skeleton map accompanying the prospectus. A letter that has come into our hands, signed by A. Harlow, shows that the Water and Gas Securities Exchange, Limited, are busy trying to place some 5½ per cent. preference shares "in a new gas undertaking, which has recently taken over a number of old-established gas companies, which have paid dividends for many years"—under their old capitals and management. The Exchange must be finding business rather difficult to effect just now, as the letter states that the "interest is guaranteed for three years by the Exchange."

Capitalism v. Municipal Ownership.

Among the matters that have been engaging attention at the seventh annual conference of the Labour Party, perhaps none is of so great importance as that which was introduced at Friday's session by Mr. W. Atkinson, who moved the following amendment to the constitution: "(1) This conference hereby declares its ultimate object shall be the obtaining for the workers of the full results of their labour by the overthrow of the present competitive system of capitalism, and the institution of a system of public ownership and control of the means of life." It might have been imagined that such a proposal would meet with, at any rate, a very considerable amount of favour at the hands of the conference; but in the result it was defeated by an overwhelming majority—the voting being nearly ten to one against it. In fact, the move was a dismal failure; and, so far as it goes, there is some cause for satisfaction in this. Mr. Pete Curran and Mr. Keir Hardie both spoke against the proposal; but this was doubtless not because they disagreed with it in principle, but because they realized that it was not in accordance with the views of the majority of those represented at the conference. Even, therefore, admitting that some of those who voted against the proposition were influenced by considerations other than the rights or wrongs of the suggested declaration against "the present competitive system of capitalism," it does not seem unreasonable to conclude from their action that Socialism is a very long way indeed from carrying all before it among the British working classes—just as it is in Germany, where the movement, as the elections now proceeding show, is losing ground rather than gaining it. Mr. Keir Hardie's admission was significant, when he said that the delegates who came to the conference represented the people behind them; and until the people behind them were Socialists, it would be a serious tactical error to attempt to enforce Socialism on them.

The Midland Junior Gas Engineering Association will meet next Saturday at the City of Birmingham Technical School, when a paper will be read by Mr. A. N. Comely, on "Refractory Materials Used in Retort-Settings."

Professor Silvanus Thompson on "The Manufacture of Light."—Our readers may remember that the lecture to working men at the last meeting of the British Association was delivered by Professor Silvanus Thompson, F.R.S., who took "Illuminants" as the subject of his discourse, which was listened to by an audience of about 2000 persons. It was noticed in the "JOURNAL" at the time; and it has now been published in a cheap and convenient form by Messrs. Macmillan and Co., Limited. Though the subject looks rather a tough one for working men, as presented in the booklet under notice, Professor Thompson brought it well within the comprehension of his audience; his lecture being made all the more intelligible by the experiments with which, by the co-operation of a number of firms and persons, he was able to illustrate it. The author has crowded into his 67 small pages of print a great deal of information, which is conveyed to the reader in language as free as possible from technicalities. The little book is well printed; but should a second edition be called for, it would be well to spell correctly, in the list of makers of photometers at the bottom of p. 14, the name of Dr. Letheby.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 296.)

THE Stock Exchange week just concluded was the reverse of cheerful. The opening was quiet, but the tone was tolerably good; some of the markets which are more liable to storm visitations being placated. The quietude continued the next day; but prices held on pretty well, aided by calmer conditions in the American Market. From this point forward to the end of the week, business became more and more restricted, and prices continued to droop as things grew deader and deader, until at last there was hardly any business doing at all. It seems as if the public mind was a prey to uncertainty, not to say apprehension—more especially in regard to prospective monetary conditions—and this being so, all enterprise is at a standstill. In the Money Market, after a little show of ease at the opening, a strong demand set in, and rates steadily increased in stiffness for short loans. For discount, the course was irregular and sometimes uncertain, but firm at the close. Business in the Gas Market made up a fairly good array of transactions in the aggregate; but it was to a large extent concentrated in the issues of the three big undertakings. The general tone was good throughout, and the market did not at all participate in the depression which weighed upon most other departments; for though changes in quotation were not numerous, they were fairly substantial advances. In Gaslight and Coke issues, the favourable effect produced in the preceding week by the dividend announcement was enhanced and intensified by the publication of the Company's accounts. There were considerable dealings in the ordinary stock at good steady figures, which all lay within the range of 100½ and 101½. The secured issues came in for more attention; and again the maximum advanced a point, with dealings at 90¾ and 91¼. The preference changed hands at from 107⅛ to 109½; and the debenture, at from 85 free to 86. South Metropolitan well maintained its activity, and prices were good and steady—marking 128½ free to 129¾. The debenture was done once at 85. There was little done in Commercials—one free bargain in the 4 per cent. at 111, and one in the debenture at 84¼, being the sum total. The Suburban and Provincial group was even quieter than usual. Brighton original was done at 234¾, British at 42½ (a rise of ½ in the quotation), and West Ham preference at 122. Without any business done, Southampton advanced 2, and West Ham ordinary 1½. On the Provincial exchanges, South Shields improved 2; but Liverpool "A" receded 1. In the Continental Companies, the feature was a rise of 3½ in Imperial, which changed hands at from 180 to 183. Union marked 127; and European fully-paid, 25. Among the undertakings of the remoter world, Buenos Ayres was done at 11⅝ and 11⅞, Primitiva ordinary at from 7 15/16 to 8 1/16, ditto preference at 5⅜ and 5 13/32, River Plate at from 12½ to 12⅝, ditto debenture at 97, San Paulo at 13¼, Cape Town at 14½, ditto debenture stock at 97¼, and South African at 15⅝ and 15¾.

The closing prices are shown in our list on p. 296.

ELECTRIC LIGHTING MEMORANDA.

Metallic Filament Lamps—The Rated and Actual Duties of Carbon Filament Lamps—Laboratory and Consumers' Conditions—Precarious Position of the Electrical Manufacturing Industry.

OPINIONS vary; and, of course, they varied largely in the discussion of Mr. James Swinburne's paper on the new incandescent lamps, which paper was noticed in the "Memoranda" last week. Some of the speakers were more hopeful than others of the metallic filaments. But where there is greatest hope, there the most favourable conditions for the new lamps are found. For instance, Mr. H. D. Munro has a 100-volt pressure at Exeter; and he has been using the Osmium lamps for the last three months, both for street lighting and for private purposes, and has now something like 2000 fixed. Osmium lamps are for low pressures; and there Exeter possesses an advantage in connection with the metallic filaments of which comparatively few other towns in this country can boast, and perhaps they do not want to. However that may be, Mr. Munro does not appear to have spoken very definitely about the candle power he is getting from these lamps. In one place, it is true, he refers to "50-candle power lamps." In another place, he says the lamps give a good average illumination—better than any low candle power lamp he has seen. Again he remarks that a great number of these lamps had an average life of 800 to 1200 hours; and, at the time, the effective candle power was within 10 or 15 per cent. of the candle power at which they started. At what actual candle power and wattage did they start; and at what actual candle power and wattage did they end their days? In his short speech, the whole tale, we fear, was not told by Mr. Munro; and there is probably something more that is to be learnt about his experience. So far as he went with it, he appears to have been especially favoured. Mr. Swinburne, in his paper, spoke of 75-volt 40-candle Osmium lamps and 100 to 130 volt 32-candle lamps. He also told of the exceedingly difficult matter it had been to make them. "Apart," he stated, "from the metal being very hard and infusible, it oxidized in the air if very fine, though this oxidation does not take place if the fine powder has been heated to

a high temperature. The peroxide of osmium formed is very poisonous. It gives off enough vapour at ordinary temperatures to cause much trouble, and especially to injure the eyes very seriously." Many figures were put forward in the course of the discussion which merely went to show that while these new lamps give higher efficiencies, the initial candle power is also higher, and thus the total watts used per hour per lamp work out in most cases at about the same magnitude as in the case of 16-candle carbon filament lamps—at the start, in both cases. It is the low candle-power lamp, with an efficiency of about 1 watt per candle, and which will work on a 200 to 220 volt system, that is the desideratum. But such lamps have not yet been discovered, and therefore the majority of electricians predict long life yet for the carbon filament lamp.

The discussion of high efficiency incandescent electric lamps has naturally emphasized the shortcomings of the low-efficiency lamps. So writes Professor L. B. Spinney in our American contemporary the "Electrical World." And it may be added that electricians evince praiseworthy candour—though knowing that the new high-efficiency incandescent lamps are, to the best of present knowledge, beyond their reach for high-voltage supplies—in making public the laxity in duty of their wares. The reason for their open attitude in this matter is that there is so much grumbling on the part of consumers as to the poor illumination obtained in comparison with the expense, that it is necessary for electricians to advise, and to give reasons for so advising, the utmost care in the selection of lamps by consumers. No reliance can be placed by the users upon the rectitude of the markings on the lamps purchased; and Professor Spinney can only suggest the desirability of proving for oneself the quality of lamps. That is precisely what the user does at the present time; and he pays dearly for the experience. It is only when he has parted with his money, that he can obtain evidence as to whether or not his lamps are up to their professed standard of virtue. There is not the slightest use unfortunately, so experience informs us, in allowing confidence to rest on the performance of a single lamp of one type; for the disparity in the deeds of carbon filament lamps of the same family is often considerable. Professor Spinney writes in the interests of electric lamp users; and he quotes the average results of a large number of tests that have been made at the Iowa State College, also in the interests of lamp users. Something over 1000 lamps were photometrically and otherwise examined; and in one table there are set out the results of the tests on 546 so-called 16-candle power lamps. The figures present the average initial mean horizontal candle power and wattage of the lamps; and they show how little confidence is to be placed on the ratings of the lamps, even in the initial stage, before deterioration commences. It will be remembered that the figures are average ones; so that they do not show how great were the flights of individual ones from specified duty. There were 119 16-candle lamps with a rated consumption of 3·1 watts per candle power per hour that gave 16·28 candles, with an average consumption of 3·11 watts per mean horizontal candle power; 378 lamps, with a rated consumption of 3·5 watts per candle power, that took 3·56 watts, and returned 15·8 candles; and eleven that did remarkably well, with a rated consumption of 3·6 watts per candle, in returning 17·5 candles for 3·55 watts per candle. The remainder were very bad. Of them 23 lamps, whose rated consumption was 3·8 watts per candle power, only returned 15 candles, consuming 4·15 watts per candle; and 15, rated at 4 watts per candle, gave 15·12 candles, on a consumption of 4·26 watts per candle. Those were new lamps; and to what condition they would arrive before consumers would discard them, is the part of their history to which Professor Spinney does not direct attention.

For reasons set forth in the preceding paragraph, there can be but little value to consumers in tests of sample carbon filament lamps conducted under laboratory conditions, except for the purpose of emphasizing their deficiencies. Even under laboratory conditions, there would have to be a wholesale rejection of such lamps—something like 40 per cent., Mr. Clifford C. Paterson, of the National Physical Laboratory, has told us—that refuse to be squeezed within the wide limits of the standard laid down by the Engineering Standards Committee (referred to last week). Further proof of this is furnished by the tests of representative lamps dealt with in the books recently issued by Mr. Lancelot W. Wild, from the Westminster Testing Laboratory, one of which—that incorporating the results of tests with incandescent gas-burners and mantles—was criticized last week. It will be remembered that Mr. Wild's method of testing incandescent gas-burners and mantles was the crude one of running the incandescent gas-lamps for 500 hours under practically the conditions that would necessarily obtain with the carbon filament lamp, without giving the former the advantage of having restored to them the original illuminating power, by the means of regulation and cleaning that their construction and intelligent use supply. Naturally, the time groups of results, as the tests advanced, showed some wonderful recessions in candle power. The third of Mr. Wild's volumes includes the tests carried out on twelve different makes of carbon filament lamp; four lamps being tested of each make. We need not go into the conditions of testing the lamps, as the resulting figures cannot be used. But it may be generally said that, under the conditions of testing by experts in the laboratory, the carbon filament lamps exhibit some very notable oscillations of candle power and consumption as between the readings of the same lamps at various periods and of lamps of the same type. There are some lamps that are better than others in this respect, and certain of them may be described as excellent in their uniform performance over the length of the photometrical trials. If in the laboratory, such discrepancy in performance is found as is here illustrated, consumers must (as we know they do) fare very badly indeed with indifferent lamps and variable voltages. The results in the volume dealing with the Nernst, Tantalum, and Osram lamps indicate the advance of these lamps in efficiency in respect of consumption, and in cases show a fair consistency with regard to illuminating values and consumption. The tests of the electric lamps in Mr. Wild's books are of more value than are those (for the reasons stated last week) referring to incandescent gas-lamps. Further information on the subject of the variable illuminating power and consumption of carbon filament lamps will be found in Mr. Paterson's paper reported elsewhere in this issue.

The electrical manufacturing industry are feeling most keenly the asperities of an accumulation of inimical conditions; and the only way out of the present troublous state appears to be by a considerable sacrifice. Who are to be the victims, is the difficult problem. No one, of course, wants to be; but it is inevitable there will have to be loss in many quarters before there can be any material gain. And it is those who have sunk money in these concerns who will have to recognize that the earning capacity of that money has been largely depreciated, and that a considerable part of it will have to be written off as having no further real existence. The "Electrical Review" describes the condition of the electrical manufacturing industry as a precarious one; and it is feared that worse remains behind. There has been only a moderate degree of prosperity; but the prices of machinery have now become distinctly unprofitable. The developments of the uses of electricity, particularly of traction, and the municipal patronage of electricity, some few years ago invited capital which swept into the plant industry with strange freedom. The result to-day is that the manufacturers, through over-competition at home, and successful pressure from abroad, are glad to keep their works going by accepting contracts at about cost. Even then they lose important contracts by under-cutting from Germany. Simultaneously, materials have become more costly; and to add to the miseries of the manufacturers, they find municipalities are hard masters and slow payers. Under such circumstances, the outlook is indeed gloomy, and the scanning of the horizon for signs of recuperation produces at the present time nothing that gives hope. The shareholders of the Westinghouse Company are heavy sufferers. When this gigantic Company started their huge works in Trafford Park, they were going to sweep everything before them, and were going to show how American ideas and methods were soon to take the lead. Let us see how this has worked out. The trading profit in the Company's last fiscal year amounted to £7630 on a share capital (not mentioning borrowed money) of £3,250,000; and the net result is a debit at profit and loss of £102,942. Nothing during the year has been written off the suspense account of £188,240; and no provision has been made for depreciation. The machinery is now becoming —some has become—obsolete; and the book value of patents and goodwill is distant from actual representation. The stock in hand and in course of manufacture is also admittedly overvalued. Economies have been brought about in the last year or two; but the foregoing is an outline of the general condition of things in connection with this huge concern. There has been over-sanguineness, mixed with mismanagement and extravagance. Result: Resolutions have lately been passed to reduce the share capital of £3,250,000 to £1,875,000, and to alter, in the Articles of Association, the nominal rates of dividend from 6 per cent. to 10 per cent. on the preference shares and 12 per cent. on the ordinary.

Early Days of Gas Lighting in London.

Yesterday was a red-letter day in the history of gas lighting in London; for exactly a hundred years ago Pall Mall was successfully lighted by Mr. Winsor with the new illuminant which he had brought under the notice of the public by his lectures at the Lyceum Theatre. A few evenings before the event, as recorded in "The Times" for Jan. 21, 1807, a select party of the nobility, among whom were Lord Minto, with his lady and friends, Lord H. Petty, and others, inspected the installation, and "seemed much gratified by the gas-flame serving for lights and culinary purposes." Among various experiments, we are told, "the boiling a kettle, and smelting ore, at the same instant, on a paper tube—burning lights under a glass globe—producing a lighthouse which no wind or water could extinguish, excited admiration." It appears that a noble party afterwards viewed the illuminations in the committee-room, saloon, and dining and drawing rooms. The last two, though not entirely finished, "showed the beautiful effects of lights by two flying Cupids and a Grecian lamp." The writer of the account added: "When the celestial hemispheres of the ceiling (corresponding with the terrestrial hemispheres of the carpet) shall be finished, the *tout ensemble*, we presume, will have a novel and classic elegance. The saloon, we hear, is to show the solar system. The noble company seemed so much entertained, that they stayed from nine till after eleven o'clock." They, as well as others, were evidently impressed with the value of the new illuminant, for Mr. Winsor projected in the course of the year a company for the manufacture of gas, and succeeded in raising a capital of £20,000.

THE GASLIGHT AND COKE COMPANY.

Half-Yearly Report.

THE following is the report on the working of this Company during the six months ending Dec. 31, which, with the accounts (see p. 293), will be submitted to the proprietors on Friday.

The accounts for the past half year show that, after providing for fixed charges, setting aside £10,000 for the half year towards the redemption fund (in accordance with the provisions of the Company's Act of 1903), and carrying £2500 to the insurance fund, there remains a balance of £353,940. The amount brought forward from the previous half year being £210,481, there is a total sum available for distribution of £564,421, out of which the Directors recommend a dividend on the ordinary stock at the rate of £4 8s. per cent. per annum, which will absorb £334,468, and leave the sum of £229,953 to be carried forward to the credit of the current half year.

The sales of gas for the half year show an increase of 1·1 per cent. over those of the corresponding half of 1905; the increase for the year 1906 over 1905 being 2½ per cent. There has been an addition during the half year of 16,693 consumers, and an increase of 20,875 in the number of gas-stoves sold and let on hire. The gratifying financial result of the half-year's working has been contributed to by increased sale of gas, better working, and the enhanced prices obtained for coke and tar products; also by a considerable reduction in the assessment of the Company's undertaking.

The London County Council are again promoting a Bill in Parliament to acquire powers with respect to the supply of electrical energy in the Administrative County of London and neighbouring areas, and for other purposes. This Bill, as in the case of the similar Bill rejected last session, will be closely watched, with the object of protecting the Company's interests as ratepayers. Certain other Bills will need careful watching; but, on the whole, so far as this Company is concerned, the forthcoming session promises to be a quiet one.

The Court of Directors has been furnished by the several Engineers of the Manufacturing and Distribution Departments respectively with the usual certificates that all the Company's plant has been maintained in thorough efficiency.

PERSONAL.

The Coventry Corporation Water Committee have received and accepted the resignations of Messrs. J. J. DERRY and W. BAXTER, Engineers at the Spon End and Whiteley Water-Works, respectively.

At a meeting held on Friday, the Directors of the Oswestry Gaslight and Coke Company, Limited, appointed Mr. E. HAMSON to the position of Manager, in succession to Mr. J. H. Parsons, whose death was recorded in the "JOURNAL" a few weeks ago. Mr. Hamson, who was selected from 178 applicants, is at the present time acting as Assistant to Mr. J. J. Jervis, the Manager of the Swindon Gas-Works.

Mr. A. E. DAVEY, who has recently been appointed Manager and Secretary of the Aberdare Gas Company, has been presented with a handsome marble clock, suitably inscribed, by the employees of the Cardiff Gas Company, whom he is leaving after thirteen years' service. The presentation was made by Mr. George Clarry, the Secretary, in the unavoidable absence of Mr. Henry Morley, the Engineer and Manager.

Mr. JAMES RANDALL, who for nearly fifty years was Secretary of the Tottenham and Edmonton Gas Company, has retired, and has accepted a seat at the Board. Mr. E. Topley, the Assistant-Secretary, has now been appointed to Mr. Randall's old position. It may be remembered, from a short history of the Tottenham Gas-Works which appeared in the "JOURNAL" for Oct. 2 last year, in connection with the visit of the Eastern Counties Association to Tottenham, that Mr. Randall's connection with the Company dates from 1851, and that he was appointed Secretary in 1857.

The position of Assistant Engineer and Manager of the Preston Gas Company, for which applications were invited in the "JOURNAL" a few weeks ago, has been filled by the appointment of Mr. S. TAGG, Assistant to Mr. T. O. Paterson at Birkenhead. Mr. Tagg was trained under the late Mr. W. R. Chester, at Nottingham; and he was with Mr. R. O. Paterson at Cheltenham before going to Birkenhead. There were 120 applicants for the position, and they were reduced successively to 38 and 5. It was a very close run between two of the latter; but the Directors thought Mr. Tagg possessed qualities which specially suited him for discharging the duties to be entrusted to him.

The Scottish Junior Gas Association, Eastern District, will visit the Glenboig Union Fire-Clay Works next Saturday. It is the intention to travel from Edinburgh by a forenoon train, *via* Larbert.

The Rothamsted Experimental Station (Lawes Agricultural Trust) has received a donation of £2000 from the Permanent Nitrate Committee, to be invested and added to the general endowment fund of the station. A donation of 100 guineas has also been received from the Fertilizer Manufacturers' Association.

OBITUARY.

WILLIAM M'CRAE.

IT is with more than the customary regret, because of the early period of life at which he has been cut off, and of the consequent untimely close of a career of promise, that we record the death of Mr. WILLIAM M'CRAE, the Engineer and Manager of the Corporation Gas Department at Falkirk, which occurred at his residence in Falkirk on the morning of Tuesday last. Mr. M'Crae was only 43 years of age. He was born in Airdrie, where his father—Mr. Boyd M'Crae—was Gas Manager. When deceased was only two years of age, his father was appointed Manager at Dundee—shortly before the transfer to the Corporation. The son was thus brought up and educated in Dundee. He was trained to his life-work by his father; and under his elder brother—Mr. John M'Crae—who later succeeded their father in the management at Dundee, he became Assistant-Manager. On the sudden death of Mr. John M'Crae, in October, 1896, at the age of 44 years, Mr. William M'Crae was appointed his successor. That post he relinquished in June, 1902. In July of the following year, he was appointed Engineer and Manager at Falkirk. While he was in Dundee, he carried through large extensions and renewals of the works; and on his arrival in Falkirk, he was at once thrown into the midst of a controversy about a site for the erection of new works. These works he built at Thornhill; and when they were opened, in May of last year, it was universally recognized that a gas-works of the most up-to-date character had been provided. Unfortunately, before the opening day, Mr. M'Crae's health had broken down; and when the ceremony was performed, he was staying at Harrogate, for the benefit of his health. He returned to office; but recently his health again gave way. In the middle of December last, he sent in his resignation, which was accepted; but his successor has not yet been appointed. Since his resignation, he has been confined to the house, and latterly to bed. On Tuesday morning, between five and six o'clock, he sat up in bed, complaining of pain, and fell back dead. He is survived by a widow, but no family. In April last, Mr. M'Crae was President of the Informal Meeting of Scotch Gas Managers in Glasgow, when he acquitted himself with much acceptance; and in July he was elected a Vice-President of the North British Association of Gas Managers. The funeral took place on Friday at Falkirk Cemetery. It was attended by the Magistrates and Town Council, in their official capacity; and there were also present about twenty brother gas managers. The Gas Committee of the Corporation, on Tuesday evening, instructed the Town Clerk to forward a letter of condolence to Mrs. M'Crae, for whom much sympathy is felt.

Gasholder "Explosion" at Montagnana (Italy).

Confusing and conflicting accounts of a serious "explosion of a gasholder" have been given in some Italian newspapers to hand. Montagnana is a small town of about 3500 inhabitants, not far from Padua, in the province of Venetia. Its gas-works belong to the firm of Giuseppe Meneghetti and Co. Increasing demands for gas had led to an extension of the storage capacity of the works, and either a new gasholder, or a new lift to an old one (according to one report), was just being completed. Apparently it was while this was being tested on the 9th inst., that the explosion occurred, which unfortunately involved the loss of three lives, besides injury to others. The holder is said suddenly to have burst; and the crown is described to have been blown out just like a plug. The actual cause of the accident is stated in the Italian newspapers to be not accurately known; but it is variously attributed to a spark from a file, or to a match struck by one of the workmen, or to a lighted candle which, it is alleged, was being used to ascertain if the holder was retaining the gas that was being at the time put into it. As far as can be judged from the meagre information at present to hand, it would seem to be an explosion caused by igniting a mixture of air and gas in a holder undergoing repairs or extensions—proper precautions not having been taken for its ventilation. The explosion destroyed all the adjacent telegraph wires; and telegraphic communication with Montagnana was cut off. The town was plunged into darkness, and the inhabitants were terrified, as they at first thought that an earthquake was taking place.

Mr. J. M'Leod, of Glasgow, read a paper, entitled "The Redistribution of the Nitrogen in the Distillation of Coal," before the Scottish Section of the Society of Chemical Industry, in Glasgow, on the evening of Tuesday last. In the course of his paper, Mr. M'Leod said the factors governing the amount of ammonia and of nitrogen and of cyanogen produced were: (1) The size of the coal when introduced into the retort. If small, the heat took longer to penetrate the charge, and, consequently, the products differed. (2) The amount of extraneous moisture the coal contained. If the coal were wet when put into the retort, experience showed an increased amount of carbonic acid, sulphuretted hydrogen, tar, and ammonia. (3) The temperature of the distillation. High heats produced a marked increase in the amount of cyanogen, and also influenced the amount of nitrogen retained by the coke.

WATER BILLS FOR 1907.

THIRD ARTICLE.

THE Metropolitan Water Board (Charges, &c.) Bill provides for uniform scales of charges for water applicable throughout the Board's limits of supply. For the purposes of the proposed Act, section 72 of the Water-Works Clauses Act, 1847, is to be read as if the words "rateable value" had been inserted therein instead of "annual value," and "twenty pounds" instead of "ten pounds." Altered as indicated, the clause will stand as follows:—

The owners of all dwelling-houses or parts of dwelling-houses occupied as separate tenements, the *rateable* value of which houses or tenements shall not exceed the sum of *twenty* pounds, shall be liable to the payment of the rates instead of the occupiers thereof, and the powers and provisions herein or in the Special Act contained for the recovery of rates from occupiers shall be construed to apply to the owners of such houses and tenements; and the person receiving the rents of any such house or tenement as aforesaid from the occupier thereof, on his own account or as agent or receiver for any person interested therein, shall be deemed the owner of such house or tenement.

In order to make uniform throughout their limits the obligations of the Board with respect to the supply of water, section 35 of the Act of 1847, relating to a constant service, and certain sections of the Acts of the eight Companies whose undertakings the Board have acquired, are to be repealed, as well as existing enactments with respect to water-rates and other charges. Clause 9 of the Bill sets forth that the Board shall furnish, at the request of the owner or occupier of any house, or part of a house occupied as a separate tenement, a supply of water for domestic purposes at a rate not exceeding 5 per cent. of the rateable value of the house or part of a house in respect of which the supply is required. The rateable value is to be determined by the valuation list in force at the commencement of the quarter for which the rate accrues, or, in the absence of such list, by the last rate made for the relief of the poor. The Board may, on being requested so to do, supply water by measure on such terms as may be agreed upon; but the price to be charged (otherwise than for hydraulic power) is not to exceed 1s. per 1000 gallons. No extra charge is to be made in future for high service. By clause 20, the expression "domestic purposes" is defined as including water-closets and also baths so constructed or fitted as not to be capable of containing when filled more than 50 gallons; but it does not include a number of purposes which are clearly specified. Provision is made for the payment of water-rates by owners of small houses; and the Board seek power to compound rates. The charge for water for public purposes is to be at the rate of 6d. per 1000 gallons; and for supplies in bulk beyond the limits, on such terms as may be agreed upon. Water-rates are to be recoverable in the same manner as those made for the relief of the poor or by action. The provisions of sections 4 and 5 of the Water Companies (Regulation of Powers) Act, 1887, are to apply to the Board as if they were a trading company; the Metropolis Water Act, 1902, is to be amended in certain respects; and the Water-Rate Definition Act, 1885, is to be repealed. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Metropolitan Water Board (Various Powers) Bill is a comprehensive measure to authorize to Board to construct water-works, acquire lands, and carry out other objects. The works comprise a tunnel under the Thames, commencing at Twickenham and terminating at Richmond, a large number of conduits or pipe-lines, a reservoir adjoining the present one belonging to the Board at Croydon, and a road in the parish of Wandsworth. The Board seek power to connect these works with those already existing, lay mains beyond the limits of supply, alter the position of their mains and pipes, and underpin houses where necessary. The period for the completion of the works specified is seven years from the passing of the Act; and an extension for a like period is asked in respect of a reservoir and a conduit or pipe-line authorized by the Lambeth Water-Works Act, 1900. Powers granted by the Southwark and Vauxhall Water Act, 1898, for the construction and completion of a pumping-station at Walton-on-Thames, and a conduit or pipe-line in connection therewith, are to be revived and continued for a period of three years. The Bill contains a scheme for the establishment of a superannuation and provident fund. Among the numerous miscellaneous provisions are some authorizing the Board to deviate from the limits specified for the Lambeth reservoir; execute works on lands at Long Ditton, Enfield, and Westerham; make agreements with the Conservators of the Thames in regard to the abstraction of water from the river; establish communication with the works by means of electricity; and alter pipes, wires, &c., under streets. The Board seek power to borrow £330,000 for the purchase of land and the execution of the works to be authorized by the Act; £350,000 for those for which an extension of time is required; £100,000 for the Long Ditton, Enfield, and Westerham works; the amount necessary for defraying the expenses of the Act; and, with the sanction of the Local Government Board, such further sum as may be required. For the three amounts specified, sixty years are asked in which to repay them; for the costs of the Act, five years; and for the further amount, such period as the Local Government Board may determine. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Bill promoted by the Ogmore and Garw Urban District Council is (*inter alia*) to authorize the Council to purchase the water-works of the local Gas and Water Company, and part of the water undertakings of the Dinas Main Colliery Company, Limited, and the Britannic Merthyr Coal Company, Limited, and Christmas Evans, and any or either of them, construct additional works, and supply water within their district. The Council are to give the Companies notice to treat for the purchase of their undertakings within a year after the passing of the Act; and until the transfer takes place, they will be carried on as at present. The Council seek power to maintain and continue the existing works, which are fully described in the Bill, and construct in addition a reservoir in the parishes of Llangeinor and Llandyfodwg, an aqueduct or pipe-line from it to another reservoir to be situated wholly in the last-named parish, and an aqueduct or pipe-line therefrom to the township of Gilfach Goch. These works are to be completed within ten years. The limits of supply are to be the whole of the Council's district in the county of Glamorgan, except the part of it included within the statutory limits of supply defined by the Garw Water Act, 1889, which is not at present served by the Company. The charges for water for domestic purposes are to be based on the rateable value of the premises. Supplies by meter are to be at a rate not exceeding 1s. 6d. per 1000 gallons; and those furnished in bulk, on such terms as may be agreed upon. The Council ask for authority to borrow for the acquisition of the existing water undertakings such sums as may be necessary; for the purchase of lands and the construction of additional works, £45,700; for extensions and improvements, £7000; and such further sum as may be sanctioned by the Local Government Board. Fifty years are required for the repayment of the purchase-money in respect of the present works, and sixty years for that borrowed for additional works and extensions. The Council will keep separate accounts of the water undertaking. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

The Penrith Urban District Council Bill is to authorize the Council, among other things, to construct additional water-works; and it will also enlarge their powers in respect of the supply of water. The new works comprise a dam for raising the level of Hayeswater, two tanks, with inlet and outlet works, and three aqueducts or pipe-lines; and they are to be completed within five years. Powers are sought to make bye-laws for the prevention of pollution of the water. The rates to be charged for water for domestic purposes are not to exceed 1s. 6d. in the pound on the rateable value of the premises supplied, according to the valuation list or the last poor-rate; and this is also to be the maximum price per 1000 gallons in the case of meter supplies. Provisions are made for the sale of water in bulk. Power is required to borrow £40,050 for the purchase of lands and the construction of works, £6650 for the extension and improvement of the water undertaking, and the amount necessary to defray the costs and expenses of the Act; the amounts to be repaid in sixty, fifty, and five years respectively from the date of borrowing. [*Parliamentary Agents: Messrs. Lees and Butterworth.*]

The Bill promoted by the St. Neots Urban District Council is to authorize them to acquire the undertaking of the St. Neots Water Company, and supply water throughout their district and the neighbourhood. Confirmation is sought for an agreement which has been entered into between the Liquidator of the Company and the Council for the sale of the undertaking for £9000; and upon the completion of the purchase, the Council will take up the supply. The Company will be wound up and the books handed over to the Council. Power is required to make additions to the existing works. The rates originally sanctioned for domestic supplies are to stand; and the Council purpose charging in addition a sum not exceeding 5s. per annum for every closet beyond the first, and a maximum of 7s. 6d. per annum for every fixed bath capable of containing not more than 50 gallons. They require authority to borrow the amount necessary for the completion of the purchase, £3000 for extensions, the money requisite for paying the costs of the Act, and any further sum that the Local Government Board may sanction. Fifty years are asked for the repayment of the two first-mentioned amounts, five years for the third, and such period, not exceeding sixty years, as may be prescribed for the fourth. Separate accounts are to be kept. [*Parliamentary Agents: Messrs. Warwick Webb and Co.*]

The Bill of the Sheffield Corporation is (*inter alia*) to confer further powers upon them with respect to their water undertaking. Authority is sought to construct two aqueducts or pipe-lines, both terminating in the existing Underbank reservoir, to be completed within seven years from the commencement of the Act; also to make agreements with millowners as to the compensation water to be discharged into the Rivers Rivelin and Loxley. The Corporation wish to be empowered to lower the charges for fixed baths or water-closets, or both, in dwelling-houses of a net annual rateable value of £50 or under, or even, if they see fit, to exempt the owners and occupiers entirely from payment. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

The Bill promoted by the Southport, Birkdale, and West Lancashire Water Board is to authorize them to purchase certain water-works from the Skelmersdale Urban District Council. An agreement has been entered into between the Council and the Board; and if this is confirmed by the passing of the Bill, the Scarth Hill undertaking of the Council will vest in the promoters, who seek power to maintain and improve it. The purchase-money is £22,500. The Board ask for authority to borrow this amount, and such sums as may be necessary for defraying the expenses incidental to the transfer, and purchasing from the West Lancashire Rural District Council certain pipes in Bickerstaffe; £1736

for connecting the Scarth Hill undertaking with their works; and £1000 for its extension and improvement—all to be repaid within a period of forty years. [*Parliamentary Agents: Messrs. Lewin, Gregory, and Anderson.*]

The Tees Valley Consolidation Bill is to consolidate, with amendments and additions, the Acts relating to the Tees Valley Water Board. The first portion of the Bill deals with the constitution of the Board, and defines the periods for which the members are to remain in office. The Board ask for authority to complete the construction of the Grassholm reservoir and of a certain conduit, notwithstanding the repeal of the Acts sanctioning these works. The Bill contains provisions preserving the rights of the Corporation to take water from rivers, and defining the quantity to be returned to them by way of compensation. Authority is sought for the sale of portions of the undertaking to the Council of any urban or rural district within the limits of supply, and beyond the boundaries of Stockton, Middlesbrough, and Thornaby-on-Tees; and also for the supply of water in bulk, under specified conditions. The charges for water for domestic use are to be based on the annual value of the premises supplied, with extras for closets and baths; but beyond the above-named boroughs they may be one-fourth more than the town charges. The Board are to be compelled to supply water for trade, manufacturing, and railway purposes, but without prejudice to a full domestic supply. The financial provisions of the Bill include power to the three Corporations constituting the Board to borrow the amounts named for the various purposes specified; and the periods for repayment are all defined. [*Parliamentary Agents: Messrs. Wyatt and Co.*]

The Tynemouth Corporation Bill is to extend the limits for the supply of water, and to enable the Local Authorities within the added area to require the Corporation to sell water to them in bulk. The extension will include a large number of districts, parishes, and places in the county of Northumberland; and they are to be supplied at a rate not exceeding 6d. per 1000 gallons and an annual sum sufficient to cover the interest on the money expended upon certain works to be constructed under the Act. These comprise four reservoirs and six pipe-lines. Borrowing powers are required to the extent of £100,000 for completing the works authorized by the Corporation Water Act of 1898, and of £2000 for making an approach road to the Font reservoir; also £62,500 for carrying out new works, £50,000 for paying interest on money borrowed, and such sum as may be necessary for defraying the costs of the Act. Sixty years are required for the repayment of all loans but the last, which has to be liquidated in five years. The money may be raised by the issue of Corporation redeemable stock. [*Parliamentary Agents: Messrs. Durnford and Co.*]

When noticing the Bills promoted by Companies (*ante*, p. 145), it should have been mentioned that the Newquay and District Water Company are applying for power to extend their limits of supply so that they shall be coterminous with those of the Newquay Urban District Council and the parishes of St. Columb Major, Colan, and St. Columb Minor Rural, all in the county of Cornwall. The existing works are fully described in the Bill, and authority is sought to construct others, consisting of two wells and pumping-stations, two headings, a covered reservoir, and eight pipe-lines, to be completed, as regards specified portions, within five years, and as to other portions within seven years, from the passing of the Act. The charges for water for domestic purposes are to be based upon the gross estimated rental of the premises supplied; with a minimum price of 8s. 8d., and a period of twelve months. Closets after the first and fixed baths are to be extras. The charge for supplies by meter is not to exceed 1s. 6d. per 1000 gallons. Authority is required to raise additional capital to an amount not exceeding £38,000, to carry 7 per cent. dividend if issued as ordinary, and 5 per cent. if as preference capital. Borrowing power to the extent of one-third is sought in respect of the new as well as of the existing capital; the latter to be inclusive of £5000 that is already raised. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

The "Graetzin" Gas-Lamp in Vienna.—According to the "Neue Freie Presse," a trial of the above-named lamp, of which some particulars were given in the "JOURNAL" for the 8th inst., has lately taken place in Vienna, in the Herrengasse and on the Stephanie Bridge, in the presence of the officials; and it was attended with marked success.

Value of the Gas-Engine.—Last Tuesday evening, a meeting of the Manchester Section of the Institution of Electrical Engineers, presided over by Dr. Edward Hopkinson, was held in the Physical Laboratory at the Manchester University. A paper on "Gas-Power Plants" was read by Mr. C. E. Douglas, in which he advanced some arguments for the installation of gas-power plant, and gave a general description of typical plants and some actual results of operation. He said that the gas-engine was the only one which was available to give power at a lower cost of operation than the steam-engine; and he held it to be proved that for industrial purposes the gas-engine, with its supply plant, was at least sufficiently reliable to warrant a greatly extended sphere of operation, and that it could be worked with more economy than any other form of power plant. On the Continent of Europe, large gas-engines had been installed and were in daily use; and this form of motor, he submitted, merited far more attention and consideration from engineers in this country.

SOCIÉTÉ DES INGÉNIEURS CIVILS DE FRANCE

Presidential Address of M. Emile Cornuault.

(*Concluded from p.* 209.)

THE WELSBACH MANTLE.

In 1885, Dr. Auer von Welsbach (taking up the same idea that Frankenstein had) arrived at a nearly perfect solution of the problem of incandescent gas, after having made numerous laboratory experiments. In principle, the Auer burner consists of a mantle formed of a framework of infusible refractory metallic oxides, suitably chosen and arranged above a bunsen burner; a woven cotton mesh is soaked in a solution of the metallic oxides which have been adopted, and the material becomes incrusted with these bodies after the style of natural petrifications; then it is burned off, and remains only a skeleton of ash, formed by the incombustible oxides, which become incandescent under the action of gas combustion.

At first, the mantle formed by the oxides of zirconium and lanthanum gave a light of a livid greenish tint, which was certainly one of the causes of the unpopularity of the new process for some years. Besides this, the mantle was very fragile. Then its life was short, and its lighting power diminished rapidly with the duration of the mantle. It was almost under these conditions that the Auer burner was presented in 1889 to the Jury of the Lighting Section of the Exhibition. Here allow me to call to mind a personal reminiscence, for I remember the discussions that took place on this subject among the Jury, and the great trouble that we had to obtain a mere silver medal for this burner, upon which I experimented in the laboratory with M. Sainte-Claire Deville. Here is the exact wording of my official report: "The light of this burner is steady and agreeable to the eye; the heat given off is slight; when the mantle is new, the carcel can be obtained with 23 litres of gas; but the efficiency diminishes with the age of the mantle (a fact that we also find in the incandescent electric lamp), and the tests of M. Sainte-Claire Deville have shown that the lighting power of 2·92 carcels with a new mantle falls to 1·41 carcels at the end of about 250 hours. The burner has improved and probably will be improved still more. As it is, the Auer burner is of a kind to render real service. . . ." It was, as you see, a little in the way of encouragement; and the sequel showed that it had been well placed. Two years afterwards, a *grand prix* would hardly have been haggled over. But this quotation, the date of which, to be exact, is the end of 1889, clearly shows that if the future of the Auer burner had been foreseen in 1889, it was yet far from possessing those qualities which were going to enable it to transform lighting by gas.

It was only in 1892, after many experiments, that Dr. Auer, by modifying the original composition, formed his mantle of oxide of thorium and a small amount of oxide of cerium (about 99 per cent. thorium and 1 per cent. cerium). This was the "Auer mixture." The oxide of cerium used in small quantity had been found to increase in considerable proportion the emissive power of the oxide of thorium. This new composition and numerous improvements in detail, which were effected little by little, completely modified the situation. The mantles supplied after 1892 gave a brilliant, warm light, "*offrant de la surface*," as it is professionally termed, notably exceeding in intensity the light of ordinary incandescent electric lamps. Also, since 1893, it is by "hundreds of thousands" that the numbers of Auer burners put up in France are to be reckoned.

THEORIES OF INCANDESCENCE.

Long before Auer, gas engineers had had the idea that gas could be better employed by using it to bring a particular refractory body to incandescence, than by only employing its illuminating power obtained directly by combustion; and it was reasoned thus: The particles of free carbon, the irradiation or incandescence of which produce the light, are contained in a small part of the volume of gas, as they only arise from the decomposition of the hydrocarbons of the aromatic and ethylic series, which, as M. Sainte-Claire Deville has shown, only account for 4 to 6 per cent. of the total volume of the gas. The other parts of the total volume do not bring any aid to the illuminating power. Though having an important calorific value, they remain unutilized in burners not based on incandescence, and it is this lost energy which the latter burners are designed to utilize.

Whatever value this explanation may have, it has been held insufficient; and it is requisite to recognize that, apart from the combustion heat of the gas, in order to explain the lighting power of the Auer mantle, it is needful that there be produced besides another action increasing the intensity of the luminous rays emitted. Several theories have been advanced. That of Dr. Bunte attributes the great radiating power of the mantle to the high temperature which the oxides of rare earths attain in the flame, due to catalytic properties of oxide of cerium. The gas combustion produces, first of all, an elevation of temperature in the mantle, and, consequently, a radiation of light from the mass of the mantle; then, in the presence of the gas flame, the cerium, by its catalytic action, raises the combination of hydrogen and oxygen, and develops a very high temperature, by which it is brought to most active incandescence.

M. Emile Sainte-Claire Deville, to whom we owe so much for scientific work concerning the chemistry of gas, also attributes

the intensity of the light produced by the Auer mantle—composed, as stated above, of about 99 per cent. of thorium and 1 per cent. of cerium—to the presence of cerium, a body the spectrum of which is much richer in luminous radiations than that of thorina (oxide of thorium) at the same temperature. But he explains—adopting therein, and following upon very conclusive personal experiments, the theory set out by Professor Féry, in 1902—that it is necesary (in order that the enormous calorific radiation of the cerite, which behaves like a dark body, may be transformed into luminous radiation), that the cerite be maintained at a high temperature. Now it is precisely this condition that is realized in the Auer mantle, by the mixture of the two oxides of thorium and cerium. The oxide of thorium, which forms the principal bulk of the mantle and gives off very little heat, stores it up in order to yield it by contact or convection to the cerite, which then is maintained at the temperature at which its intense radiation shows itself in a luminous form. In other words, the role of the thorina is merely to serve as a support to the radiant body, or, to use the expression of M. Sainte-Claire Deville, to keep the cerite hot.

To summarize, the primary condition for an incandescent mantle is for it to be constituted in the desired proportions by two sorts of bodies—one radiant body of great emissive power, and another warm body of very slight emissive power, which serves as a vehicle to the preceding one.

Improvements in Burners.

The mantle once invented, it was necessary to form the burner *ad hoc*—that is to say, the special bunsen burner intended solely to supply heat to the mantle, and to bring its temperature to the highest degree possible by incandescence. The construction of this burner has exercised, and still exercises, the ingenuity of inventors and manufacturers. Improvements in detail, allowing of bettering the conditions of the carrying in of the air, and therefore those of the combustion of the mixture of air and gas, play in fact a very important role, both as regards the good working of the burner and its efficiency—that is to say, the economy of its consumption. In principle, the arrangement of the burner ought to be such that the gaseous stream leaving by the inlet hole should produce a draught of air similar to a kind of Giffard injector. The intimate mixture of gas and air ought to be also studied. M. Denayrouze has, even in this direction (1895), gone as far as working mechanically the stirring up of the mixture by means of a small electric fan; but he soon gave it up, to use other more practical means. Bandsept (1896), in the same direction, sought to improve the burner by means of baffles, which produced the mixing of the two fluids; but the active force of the gaseous mixture was reduced, to the detriment of the efficiency. He then gave up using the baffles, to adopt adjustment by placing conical pieces on top of one another, so as to produce a progressive mixture of gas and air. Then, in the latest type, he interposes above the injector and the inside of the first of two cones, a piece forming a Giffard injector separating the two levels of the openings through which the air is introduced. By other arrangements, the Kern burner effects similar advancement. It also has an injector by which the gas sucks in the air; and the mixture first goes into a perforated strainer, and then into a chamber placed below the burner, and in which it is considerably heated. More recently, the Busquet burner, made by the Société Auer under a special mark, effects improvements of the same kind by two injectors, one above the other, the relative position of which is varied by means of a helicoid groove. By the combined play of the two injectors, regulation is thus obtained which allows of modifying and adjusting the volume of the flame to the mantle utilized. In all improved burners, in short, what is sought is to realize the best practical conditions to raise the temperature of the flame as much as possible.

Improvements in Mantles.

The mantles, like the burners, have also undergone improvements in details, and have become less fragile, &c., due to the care taken in manufacture, and to the purity of the oxides, &c. But the material of the mantle remains the same. It was only in 1904 that, by the Chardonnet process, known under the name of Plaissetty mantles, mantles with a base of artificial silk were substituted for those with a cotton base. These silk mantles have more cohesion, elasticity, and homogeneity, and this without increasing the mass, which is an essential point. In these mantles, the lighting power is a little higher, and, above all, it is maintained much more stable than in mantles of knitted material.

Extension of Incandescent Burners.

Incandescent gas-burners have been much longer in being adopted for public thoroughfares than for the interior lighting of houses; and the fact is well explained by the fragility of the mantles at their first appearance (1892). They were ill-fitted to resist the vibrations of the ground produced by the passing of vehicles; and there were difficulties relating to lighting up, and also in the price of the mantles themselves, which then cost about 3 frs. It will be understood that the maintenance, under such conditions, was very heavy. It was, however, quite tempting, by the substitution of an Auer burner of 115 litres (and even less) for a flat-flame of 140 litres, to quadruple at least the illuminating power, at the same time effecting an economy of 25 litres per hour, or nearly 100 cubic metres (3530 cubic feet) per year per lamp. Also, everyone tried everywhere in this direction, and, little by little, all the difficulties were overcome.

In 1894, there were lighted the Champs-Elysées, the Place de la Concorde, which made a sensation, the Place du Parvis Notre-Dame, the Place du Trocadéro, &c., with a thousand lamps. Each year the progression mounted up: In 1898, 2092 burners; in 1900, 19,256; in 1901, 41,303; in 1902, 48,962; and in 1905, 50,437. This is out of a total of 52,313 burners, independently of 3728 on private roads maintained by the City. The transformation was therefore all but complete in 1902.

The burners at the beginning were of 115 litres, rarely of 150 litres. Now they are of very variable consumption. In 1905, for example, there were:

1,906	burners below 100 litres.	
41,167	,, of 100 ,,	(more than four-fifths).
124	,, of 120 ,,	
4,897	,, of 150 ,,	
2,032	,, of 150 to 300 litres.	
311	,, of 300 to 750 ,,	

Soon burners of different systems (Lacarrière, Denayrouze, Kern) of only 80 litres will be put up in Paris. We wish, on the other hand, that at the cross-roads, and in the squares, &c., the intensive incandescent gas-burners would be increased, as they have been adopted with success for shop entrances, café terraces, &c., as well as for factories and workshops. With consumptions of from 450 to 700 litres, intensive burners can be had which rival the electric arc—that is to say, they give an intensity of from 40 to 60 carcels. The Provinces have, of course, followed the movement, and generally, public thoroughfares are lighted by incandescent gas-burners everywhere.

Such is the much abridged summary of the progress of incandescent gas since its discovery. As to the results of it, which we have enumerated, they may be expressed as being, since 1892, an economy of about 50 per cent. in the consumption. Burners No. 1 of 75 litres, and No. 2 of 115 to 120 litres, which were then the most general, consumed from 20 to 25 litres per carcel. The improved burners, like those of which we have spoken, now give the carcel for practically 10 to 12 litres, and even 8 to 10 litres in the laboratory. There is, in addition, the whole gamut of various intensive (or high pressure) burners from 30 litres up to 700 litres and more.

Gas and Electricity Compared.

It is of interest to try and compare incandescent gas and incandescent electricity from the point of view of expense. Adopting, for example, the respective base prices of 20 c. per cubic metre for gas, and 8 c. per hectowatt for electricity—these two base prices being average prices, which could both be lowered proportionately without much altering the comparison—we have:

For the gas carcel-hour: $\frac{10 \text{ litres} \times 0{\cdot}20}{1000} = 0{\cdot}002$ frs.

For the electric carcel-hour: $\frac{30 \times 0{\cdot}08}{100} = 0{\cdot}024$ frs.

(at 3 watts per candle or 30 watts per carcel).

The cost of gas is, therefore, twelve times less. With a less perfect incandescent burner, giving the carcel for 12 to 13 litres instead of 10 litres, the cost would still be about ten times less for gas than for electricity.

These figures, which are very conclusive from the point of view of saving in money, and which explain so well, if the expression may be allowed, the *democratization* of gas, which is more and more marked, show, on the other hand, that economy is not everything in the question of light. Luxury, decorative appearance, easy division of light, facility of lighting up, are paid for like other things; and there is need to recognize the superiority of the electric light on these interesting points. But progress links up and leads on; and gas has also sought to follow electricity into the decorative domain, if it may be thus expressed. The inverted burner, invented only a few years ago, under various names (Farkas, Liais, Rieder, &c.) now enjoys a great vogue, precisely because of the special decorative applicability of which it is capable.

Inverted Burners.

In these burners, the flame leaves the burner vertically from top to bottom, and renders incandescent a mantle in the form of a spherical crown, with the convex side turned to the ground. The burner, being above the incandescent surface, does not throw any shadow on the objects placed below it. The radiation from top to bottom is rational. It gives, in the main, an analogous result to that formerly obtained in certain regenerative burners, called Wenham burners, and also to that in incandescent electric lamps. With inverted burners, it is easy to get elegant fittings with ground-glass tulips, &c., such as pendants, chandeliers, &c.—advantages to which must be added the undoubted attraction—we say it—of imitating the electric light so correctly *à la mode*. It is this type of burner which has been particularly adopted by the Compagnie des Chemin de Fer de l'Ouest for lighting their waggons with ordinary coal-gas, compressed to 15 kilos. in the cylinders. A regulator reduces the pressure of the gas at the burners to 180 millimetres, and, with only 40 litres consumption per hour, there are obtained more than 32 candles—actually flooding the compartment with light. However that may be, it is right to say that, since the development of incandescence, and, above all, with the assistance of inverted burners, gas can defend itself even in the decorative department; and it has gained admittance in average bourgeois houses, into dining rooms, and even drawing rooms,

from which it seemed to all ever banished with the old flat-flame burner, relegated as it then was to kitchens or halls.

Progress in Efficiency of Gas-Burners.

Will you permit me now, returning to the past, to throw a retrospective glance on the technical progress of lighting by gas during the period which has seen the birth and development of electric lighting—that is to say, about 25 years. The results are summarized in the following table giving, for successive types of burners, the consumption in litres per hour, the lighting power produced in carcels, and the consumption per carcel and per hour.

		Consumption in Litres per Hour.	Lighting Power in Carcels.	Consumption in Litres per Carcel per Hour.
Before 1878 Flat-flame burners	1st series . .	100	0·77	129
	2nd series . .	140	0·10	127
	3rd series . .	200	1·72	116
Round burners, Bengel type . .		105	1	105
Intensive burners without regeneration (Rue du Quatre-Septembre, &c., type)		1400	14	100
Regenerative burners.		350	4 to 5	70
		750	13 to 15	50
		1000	20 to 22	40 to 45
Incandescent burners	ordinary .	100	5 to 6	16 to 20
	improved .	variable	—	10 to 12
	intensive .	300 to 700	30 to 70	9 to 10

Thus, therefore, whereas in 1878 we had only burners giving the carcel for 125 to 130 litres, and able only to reach the power of a few carcels, we now have, at the present time, burners giving the carcel for 10 to 12 litres—that is to say, ten times less. The efficiency has therefore increased ten-fold at the same time that we have been able easily to get lights of great power. Can it be said then, of this industry, that it has not marched with progress? There are not many industries which in a few years have seen realized such increases in efficiency, and it is a statement which I felt bound to put before you, with figures in support of it.

To sum up, the reduction in the consumption of improved burners has been one of the most profitable things to the consumer. As to the reduction in the price of gas—this famous question, which is always talked about but which is so little solved, in Paris at least—one would like to remark that the reduction of 40 to 50 per cent. on the price per cubic metre, which represents the maximum demand of the consumer, is a small thing alongside the reduction of 90 per cent. in the consumption which has been procured for him, solely by technical progress in lighting.

Consumption of Gas in France.

After having rapidly passed in review before you the successive stages and the principal advancements in lighting by gas, I now come to the present state of the gas industry in France and abroad. Has the very large place which the electric light has so rightly taken in the general world of modern lighting checked the progressive march of the gas industry? Is it not to be supposed that the latter will soon have to give place to its brilliant rival? Such is the question that was put, and is still put by independent minds. It is one to which hardly any answer can be given except by a statement of figures carefully selected. Forgive, then, a few statistics.

At the Exhibition of 1889, in the official report of the Jury on Lighting, I showed a consumption of 620 million cubic metres for the whole of France, with 1028 communes lighted by gas, having a population of 12,750,000. It is in fact during this period—that is to say, during about 15 years—that the electric light has really developed. I remind you in particular that it was in 1889 (April) that the first concessions were given to the Electric Companies or *Secteurs* of Paris, and that it was only after 1889, with some exceptions, that the Provinces, little by little, followed the movement started in the capital. This development, in Paris, for example, is shown by the following figures:

Year.	Consumers.	Arc Lamps.	Incandescent Lamps.	Kilowatt-Hours Consumed.
1889 . .	216 ..	469 ..	19,380 ..	480,986
1899 . .	19,815 ..	12,572 ..	840,959 ..	17,903,668
1905 . .	41,708 ..	16,964 ..	1,551,660 ..	34,368,312

So that it is precisely in this same period that the development in the consumption of gas is shown also in the most striking way; it being thus parallel to that of electric lighting. Replacing official gas statistics, which are wanting in France, by estimates and personal information, we reach an actual gas consumption for the whole of France of about 900 million cubic metres, which is more by nearly 50 per cent. than the consumption in the year 1889, and is applied to a population of about 13½ million inhabitants out of 39 millions.

If we now make our comparisons as regards Paris, instead of for the whole of France, we shall see that, in the last decade, the consumption passed from 270 millions in 1897 to 350 millions in 1906—that is, an increase of 30 per cent., in spite of the rapid progress of electric light. If the consumption is brought down to the basis of per inhabitant, which is the most interesting form because it takes the variation of population into account, the consumption per head passes then from 105 cubic metres in 1897 to 130 cubic metres in 1906. Large towns in France which I might cite have undergone similar developments. I will name Lyons especially, because of the considerable electrical increase that has occurred there, owing principally to the utilization of the Rhône for motive power. The gas development there is stated to be more than 40 per cent. increase for the last known ten years, and the present consumption per head is nearly 80 cubic metres. Let us now look abroad.

Consumption of Gas in Other Countries.

England.—Of all countries in the world, England is the biggest consumer of gas in proportion to its population. The production is quite five times that of France, or more than 4000 millions of cubic metres. London consumed, in 1890, 748,000,000 cubic metres, and in 1905, 1,022,000,000 cubic metres. This is an increase of 274,000,000 cubic metres, or 36 per cent. The latter figure (of consumption) corresponds to about 180 cubic metres per inhabitant—a figure which is much higher than that of Paris. Industrial towns, such as Manchester and Birmingham, reach even nearly to 250 cubic metres per head. These figures show sufficiently—though one must not forget to take into account the differences of climate, the commercial character of the towns considered, local habits, price of gas, &c.—how far we are in France from the "limit of saturation" (excuse the barbarous expression) of the consumer.

Germany.—The use of gas is also greatly developed in Germany; and here is the progress in consumption for the last specially considered decade, in three large towns amply supplied with electricity, which are quoted as examples:

Berlin: In 1894, 111,000,000 cubic metres.
In 1904, 212,000,000 ,, ,,
That is an increase of 101,000,000 ,, ,, or 90 per cent.

Hamburg: In 1894, 41,000,000 cubic metres.
In 1904, 67,000,000 ,, ,,
That is an increase of 26,000,000 ,, ,, or 63 per cent.

Cologne: In 1894, 24,000,000 cubic metres.
In 1904, 40,000,000 ,, ,,
That is an increase of 16,000,000 ,, ,, or 66 per cent.

These figures correspond to a consumption of from 90 to 110 cubic metres per inhabitant.

Belgium.—Very complete figures are known for Brussels, or, more accurately, for the combined Brussels districts, which are, it is true, particularly densely populated.

Brussels: In 1895, 30,000,000 cubic metres.
In 1905, 43,000,000 ,, ,,
That is an increase of 13,000,000 ,, ,, or 43 per cent.

The last figure of consumption corresponds to one of 224 cubic metres per inhabitant.

Holland.—As for Germany, I take as examples the figures of three large towns, which I have been able to obtain for the last five years:

Amsterdam: In 1899, 34,600,000 cubic metres.
In 1904, 62,200,000 ,, ,,
That is an increase of 27,600,000 ,, ,, or 79 per cent.

Rotterdam: In 1899, 24,700,000 cubic metres.
In 1904, 35,300,000 ,, ,,
That is an increase of 10,600,000 ,, ,, or 42 per cent.

The Hague: In 1899, 20,200,000 cubic metres.
In 1904, 32,400,000 ,, ,,
That is an increase of 12,200,000 ,, ,, or 60 per cent.

These figures correspond to 100 to 130 cubic metres of consumption per inhabitant.

Sweden. — Stockholm: In 1894, 15,300,000 cubic metres.
In 1904, 29,800,000 ,, ,,
That is an increase of 14,500,000 ,, ,, or 94 per cent.
The last figure corresponds to 94 cubic metres per inhabitant.

Denmark.—Copenhagen: In 1894, 27,100,000 cubic metres.
In 1904, 52,500,000 ,, ,,
That is an increase of 25,400,000 ,, ,, or 94 per cent.
The last figure corresponds to 124 cubic metres per inhabitant.

Switzerland.—Zurich: In 1898, 9,780,000 cubic metres.
In 1905, 20,176,000 ,, ,,
That is an increase of 10,396,000 ,, ,, or 106 per cent.
The last figure of consumption corresponds to 120 cubic metres per inhabitant.

Basle: In 1894, 6,060,000 cubic metres.
In 1904, 14,337,000 ,, ,,
That is an increase of 8,227,000 ,, ,, or 136 per cent.

Geneva: In 1894, 6,900,000 cubic metres.
In 1905, 8,830,000 ,, ,,
That is an increase of 1,930,000 ,, ,, or 28 per cent.
The consumptions vary between 80 and 120 cubic metres per inhabitant.

Italy.—Milan: In 1895, 24,100,000 cubic metres.
In 1905, 52,700,000 ,, ,,
That is an increase of 28,600,000 ,, ,, or 118 per cent.
Consumption about 100 cubic metres per inhabitant.

Rome: In 1895, 13,900,000 cubic metres.
In 1905, 19,800,000 ,, ,,
That is an increase of 5,900,000 ,, ,, or 42 per cent.

I can also, for these two Italian cities, give the corresponding development of electric lighting, which has been considerable:—

Milan: In 1895, 26,317 incandescent electric lamps and 978 arcs.
In 1900, 47,211 ,, ,, ,, ,, 1332 ,,
In 1905, 235,027 ,, ,, ,, ,, 3212 ,,

Rome: In 1895, 51,100 incandescent electric lamps.
In 1905, 213,884 ,, ,, ,,

These examples, which I could add to, are sufficient to show that the gas industry has never been more progressive than

during the same period as the development of the new method of lighting by electricity. This result may appear surprising, and it is interesting to analyse it.

Reasons for the Progress of Gas.

In the first place, the coming of the electric light had, as a first result, the general raising of the level of artificial illumination. Light calls for light. The inevitable tendency was, from that time, to demand more from the other known methods of illumination which were to hand, and especially from gas, which was in possession with its installations ready and its new methods of working, which we have passed in review, arising principally from the invention of incandescent burners, which at once gave greater lighting power and economy.

We would also say that frequently the electric light is a partial addition to, rather than a total substitution for, gas. Gas companies so well understood this that, abandoning their prejudices and first-hour struggles, many of them boldly threw themselves into the new path that was offered to them by the electric light, and did not hesitate to seize the opportunity of new agreements to turn themselves into general lighting companies, offering at the same time to their customers, under specially simple conditions, the choice between gas and electricity. This was the case in many large towns in France; and I may mention at the head of them the three largest, Marseilles, Lyons, and Bordeaux.

Heating by Gas.

I must take care not to forget the more and more spreading intervention of gas for the usages of domestic heating, cooking, &c., which makes it an indispensable auxiliary of modern comfort, and is so well adapted for moderate establishments, which we should not forget are the most numerous. This application of gas, though well known from the beginning, has only really been put into extensive practice in the last few years, and especially since reduced prices became general in France. The advantages of gaseous fuel, piped under the public street and arriving at the floor in any quantity asked for, in place of coal which it is necessary to cart, store, carry up, &c., do not any longer require proof. A day will come when the coalman carrying the coal upstairs will follow the fate of the water-carrier that we saw in our youth bearing the two traditional buckets on his broad shoulders. Civilization involves, let us not forget, mains as much for heat, light, &c., as for water. There are, therefore, to be considered, in order to have correct ideas on the matter, during the period we have especially examined, two distinct progressions; the progress of lighting and the progress of heating.

Statistics of Lighting and Heating by Gas.

In France, the ascertaining of particular figures for each of these two usages is very often difficult of achievement. They are estimated rather than measured by the quantities of gas sent out during the day and those sent out at night. This is only an indication, a simple probability and sometimes even erroneous. Rather more precise statements can only rarely be obtained from towns in France, but frequently from abroad (Germany, Switzerland, &c.), where, different prices being allowed for lighting purposes and for heating, two distinct meters register separately the respective consumptions.

I will spare you the rather cumbersome statistics which I have collected on this subject; but in order to summarize them, I will simply put before you, as an example, the separate progress of the consumption of gas in two large towns abroad, taken as modern types of towns (I emphasize this point) in which the electric light is extensively developed:—

Year.	Town I.		Town II.	
	Lighting. Cubic Metres.	Heating. Cubic Metres.	Lighting. Cubic Metres.	Heating. Cubic Metres.
1896 . . .	11,764,000	13,813,000	4,945,000	1,727,000
1897 . . .	11,840,000	15,488,000	5,353,000	2,402,000
1898 . . .	12,262,000	17,483,000	6,012,000	3,048,000
1899 . . .	12,364,000	19,195,000	6,729,000	3,844,000
1900 . . .	12,993,000	21,932,000	7,220,000	4,619,000
1901 . . .	12,775,000	24,227,000	7,108,000	6,264,000
1902 . . .	13,827,000	28 226,000	6,684,000	7,724,000
1903 . . .	14,278,000	30,706,000	7,044,000	9,152,000
1904 . . .	13,960,000	31,650,000	7,940,000	10,416,000
1905 . . .	13,884,000	33,474,000	7,884,000	11,597,000

As will be seen by these examples—and I could cite many others—the considerable increases experienced in the later years are due, particularly in large towns, to the adoption of heating, stimulated by important reductions in the price of gas. This large field of action is far from being exhausted. In the sphere of lighting, the progress has been more modest, and clearly shows that there is competitive ground on which the two rival lights meet, which have to reckon with their respective qualities, as with the progress accomplished and to be accomplished.

The Future.

On the gas side, we can still discount the effect of new improvements in incandescent burners, and of fresh reductions in price, both of the cubic metre and of the accessories—especially if the towns do not put forward pretentions for exaggerated royalties, as in Paris, where they exceed 7 centimes per cubic metre—so that in a word, there may be brought by one pipe to the humblest household, at the same time, the benefits of both light and heat under undisputable economical conditions.

On the side of electricity, we can also discount the lowering of the price per hectowatt, which is becoming general everywhere, and which, especially in Paris, is only a question of hours; and also the progress of incandescent lamps, which have recently been put before us so admirably by our colleague, M. Larnaude. It is by carefully following these improvements and measures that reasonable forecasts for the future can be made, rather than by relying on facts of the past in order to build up ready-reckoners which have never been really mathematical.

We who are here as free engineers, devoted above all to progress, have to rejoice at these struggles, at this constant march towards that which is "better." There is room for everybody in the vast field of lighting; the scope of light is, as we said at the beginning, indefinite—gas, petroleum, acetylene, electricity, &c. There will never be enough sources of light to suffice for the ever-increasing needs of the modern man, who desires, at his will, to be able to do away with night, as by the telegraph and telephone, he has already succeeded in doing away with distance. It will be the honour of many among you to have participated, in different spheres of action, in the characteristic evolution, accomplished in the last century, which has so justly obtained for it the name of the "Century of Light."

A MODERN PHASE IN THE MANUFACTURE OF SULPHURIC ACID.

By H. Leicester Greville, F.I.C., F.C.S., &c.

A recent paper read before the Society of Chemical Industry* by Mr. W. H. Colman—on "A Graphical Method of Recording the Work of Vitriol Chambers"—recalls to my mind some general considerations concerning the manufacture of sulphuric acid. It is almost needless to call attention to the importance of sulphuric acid to all gas-works manufacturing sulphate of ammonia—whether they are purchasers of the acid from outside sources or are (as at present in many large works) their own manufacturers. The paper I have alluded to is of too technical a character to admit of a brief description—suffice it to say that, by a careful daily observation of all the salient details which effect efficiency and economy in manufacture, the author frames a chart which enables a graphic appreciation to be made of the general working, and a comparison *de die in diem*.

The present short article is not intended to, in any way, discuss the well-known chamber process of sulphuric acid manufacture, but to call attention to a comparatively modern innovation which does not apparently seem to have met with the recognition which might have been expected, and of which a few brief comments may be of possible use and interest. The method to which I allude is the so-called "Contact" or "Catalytic" process, where certain metals or metallic oxides are used for the conversion of sulphur dioxide into sulphur trioxide.

Digressing to the present ordinary method of manufacturing sulphuric acid, sulphur dioxide is formed by the combustion of sulphur-laden materials in contact with air (pyrites, spent oxide, &c.). The sulphur dioxide in contact with free oxygen, steam, and nitrous vapours is eventually converted into sulphuric acid. The function of the nitrous vapours (higher oxides of nitrogen) is to act as oxygen carriers to convert the SO_2 into SO_3. This reaction necessitates comparatively long contact; so that the reacting gases have to be allowed full play in a series of large and expensively constructed lead chambers. Moreover, as the nitrogen oxides are necessarily expensive, special apparatus has to be used to prevent loss, and for their recovery. All this is, to many, common knowledge; but a brief recapitulation may possibly make comments on the so-called "contact process" clearer.

In the last edition of Professor Lunge's work, on "Sulphuric Acid," of which a brief review appeared in the "Journal,"† considerable prominence was given by the author to the "catalytic" process of sulphuric acid manufacture. I have unfortunately not the book for reference, but made one or two notes at the time I read it. In brief, at certain temperatures the oxides of copper, iron, and chromium have the faculty of immediately effecting the union of SO_2 with O to form SO_3. Finely divided platinum is the most active agent; but its excessive price rather tends to make its extensive use somewhat prohibitive. Professor Lunge is inclined to the belief that the so-called catalytic action is due to a function of oxidation and deoxidation. Thus, in the case of iron, he gives the reactions—

$$1.—3\ Fe_2O_3 + SO_2 = 2\ Fe_3O_4 + SO_3$$
$$2.—2\ Fe_3O_4 + O = 3\ Fe_2O_3$$

In the case of platinum, the effect is not so clear; but it is quite possible that some form of alternate oxidation and reduction may take place.

Oxide of iron requires a comparatively high temperature (a low red heat) to effect the union of SO_2 with O; and the complete reaction never occurs even under the most favourable circumstances. With platinum, however, the reaction is complete under the best conditions so far as to practically reach theoretical

* "Proceedings of the Society of Chemical Industry," Dec. 31, 1906.
† Vol. LXXXIV., pp. 469, 471.

limits. Experiments made by the author prove that while a certain temperature is necessary, excess of heat causes dissociation—viz., that the SO_3 molecule breaks up into $SO_2 + O$.

An experiment showed that the first evidence of the combination of SO_2 and O started at 200° C.; increasing rapidly with rise of temperature. At 380° C., a conversion of SO_2 into SO_3 amounted to 98 to 99 per cent., continuing up to 430° C. A further increase in temperature resulted in dissociation setting in, so that between 700° C. and 750° C. there was only 60 per cent. conversion; while at 900° to 1000° there was no action. With a mixture of ferric and cupric oxides, there was a 10 per cent. conversion at 400° C.; a 35 per cent. at 500°; and a maximum of 45 per cent. at 550°.

Since the production of Professor Lunge's treatise, the contact process has come into practical use in America. I have, however, no later statistics than those published early in 1906.

The Verein Chemischer Fabriken Company adopt a method which utilizes oxide of iron as the main agent for converting SO_2 into SO_3—the final reaction being effected by platinum.

It appears necessary in the commercial working of the process that (contrary to the ordinary chamber method) moisture must be excluded. The combustion of the sulphur-laden material is effected by air dried by the strong sulphuric acid produced in the course of manufacture. The combustion products (SO_2 and excess of air) pass to a shaft containing pyrites cinders (crude oxide of iron). The gases have sufficient heat to maintain these at the necessary temperature to convert a certain proportion of the SO_2 into SO_3; while any arsenic is retained in combination with the iron. The sulphuric anhydride is condensed; and, eventually, the remaining unchanged SO_2 is converted into SO_3 by contact with heated screens of platinized asbestos. The claims are that by the process a conversion of 95 per cent. of the original SO_2 into SO_3 takes place.

The practical statistics given are that one plant was installed at Buffalo, N.Y., in 1903, with a capacity of about 1600 tons of acid. This has since been enlarged fourfold. Four other firms have since adopted the process with a capacity of 35,000 tons, and plant (in course of construction) to yield a further 16,000 tons. I am simply quoting published figures. Unfortunately, no statistics are given as to cost of manufacture; but looking at the science of the question, the more modern method would seem cheaper than the old-fashioned lead chamber system of sulphuric acid manufacture, with its costly apparatus, its constant necessary expenditure of nitre, and its continual careful supervision.

A REINFORCED CONCRETE RESERVOIR.

A RECENT number of "Engineering Record" contained an illustrated article by Mr. Bertram Brewer, the City Engineer of Waltham (Mass.), on the construction of a reinforced concrete reservoir for the supply of the town. The water comes from an underground source, and is pumped from a large well near the Charles River. The original works, completed in 1873, included an open well and filter gallery with an open 6 million gallon reservoir on a hill about 1500 feet to the north. The objectionable growths common to underground waters when exposed to light soon appeared; and in 1893 the well and gallery were covered, and in 1906 a new covered reservoir was built and put into service. The authorities were aided in their decision as to the kind of structure to build by having before them complete plans and estimates. A covered concrete reservoir of a familiar type, circular, buried in the earth, and large enough to contain 2½ million gallons of water, was estimated to cost about $14,000. This would require taking considerable additional land. A steel tank, 100 feet in diameter and about 36 feet high, would contain a little more than 2 million gallons, and would cost about $30,000. Such a structure would require a considerable outlay for maintenance; but it could be built mostly on water-works land. Plans were prepared and a thorough investigation was made into the cost of a concrete structure of dimensions similar to a steel stand-pipe, and, like it, to set above the ground. This last design was finally adopted, and the concrete reservoir has been built at an actual cost of $25,556.

The reservoir rests mostly on ledge. The bottom is 12 inches thick, reinforced with a layer of expanded metal near the surface. The floor is trowelled to a granolithic finish. Bent rods, spaced every 12 inches, were placed in the base. They extend 6 feet into the base of the reservoir, and 3 feet up into the wall. The walls are 18 inches thick at the bottom, the inside vertical and the outside battering 6 inches; making the thickness at top 12 inches. Enough steel reinforcement was used in the walls to keep the tensile stress within a 12,000 lbs. limit. The rods were arranged in three rows up to 20 feet and then in two rows in the next 17 feet. The roof consists of a reinforced concrete slab 3 inches thick, supported by steel trusses radiating from a central concrete-covered pipe column, which serves also as an overflow. These trusses are 3 ft. 8 in. high at the outside ends, and an ornamental enclosure wall was built up round and above them—making the total height of the side walls 43 feet. Except in the foundations and lower 6 inches of the floor, which was composed of a 1 : 3 : 6 mixture, the concrete was proportioned at the rate of 100 lbs. of cement to 2 cubic feet of sand, 4 cubic feet of stone, and 5 lbs. of hydrated lime. The walls were reinforced with 1⅛-inch round rods; and the jointing of the rods was made in every case by a lap of 40 diameters. The cement was required to conform to the standards for portland cement adopted by the American Society for Testing Materials; and the Contractor used Lehigh cement. Most of the stone and all the sand was screened from a gravel bank not far from the site.

As most builders have found to their cost, there are certain inherent difficulties in manufacturing concrete which usually render it permeable to water. It was therefore with great study and care that the plans and specifications for the reservoir were prepared. In the American climate, it is perhaps not so much a question how to stop all percolation as it is to reduce it to so small a quantity as to avoid injury from frost. The peculiar, if not unusual, precautions taken to make the building a success may be grouped under the following six heads: (1) As to the character of the sand and gravel which entered into the aggregate. (2) As to some waterproofing material or compound to be added. (3) As to the method of placing the steel and holding it in position. (4) Forms. (5) Making the joints and caring for the concrete as it set. (6) Interior finish of the walls.

For waterproof work, Mr. Brewer employed gravel up to 1½ inches in diameter; using by choice the rounded pebbles, because they pack more easily and made a denser concrete. Mechanical analyses of the sand and gravel were made, and specified proportions of maximum and minimum sizes were adhered to throughout. Permeability tests were carried out of two waterproofing materials on the market. Both notably increased the impermeability of the concrete; and it was decided to use the lime in the body of the concrete to the extent of 5 per cent. of the weight of the cement, because it gave excellent results and was cheap. The steel was rolled to the required radius on the ground, and placed in the angles of open lattice-work perpendicular steel supports as the wall was built up; the ends being tied together with wire where found necessary in order to keep them from sagging.

The forms were erected in complete sections 3 feet high. They were about 5 feet long; so that it took sixty to make the circle. The difference in lengths due to the batter of the outside of the wall was adjusted as the building progressed. The outer and inner portions of each section were tied together with four ½-inch bolts. These were in three sections. The middle one, with the two heads into which it was screwed at either end, was permanently built into the wall; while the two outer ones were unscrewed from the other ends of the heads upon removing the forms.

The contractor built two complete sets of these forms, or really enough for 6 feet of wall. In making the joints, the old surface was thoroughly cleaned with steel brushes down to hard material, and then washed out with a hose. The old work was wetted down, and a layer of neat cement grout brushed in immediately before adding the concrete. New concrete was kept covered and wetted down daily for a month; but no attempt was made to fill the reservoir until it was completed. The first 10 feet of the inside wall was plastered with a mixture of sand, cement, lime, and Medusa compound, and the remainder received at least two brush coats of a mixture of sand, cement, and the compound.

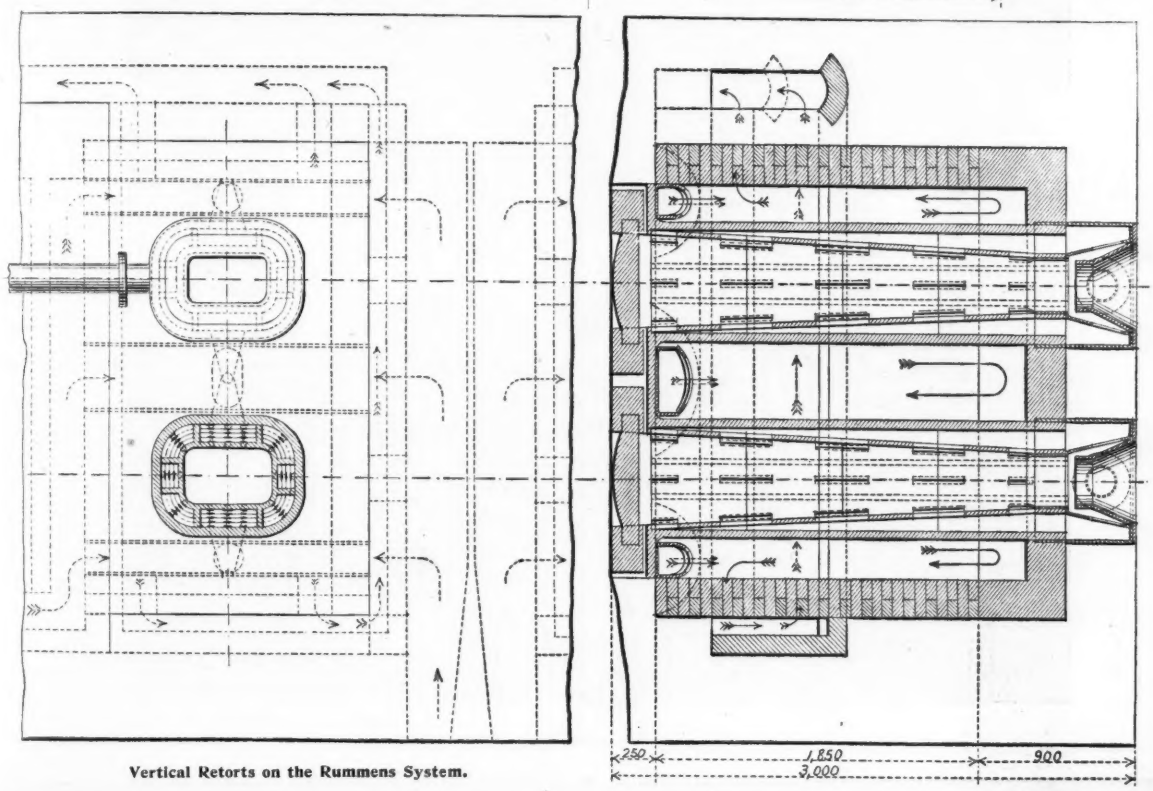
Every structural difficulty was met as Mr. Brewer had expected to meet it before he began. There was no movement whatever in the forms, and it was not at all difficult to secure the battered walls. The rounded stones were easily packed into position; and there were no poor sections of concrete and no leaks. A lack of suitable pumping facilities greatly delayed the progress of the work; and as a result of this, and an insufficient water supply, there was considerable seepage at the joints. Up to the present time no effort has been made to add to the treatment already described which the inside walls received when they were first built, with the exception of another brush coat at the joints. In a letter to the City Government last February, when preparations for the work were in progress, Mr. Brewer stated that, if the plans and specifications were carried out, he believed it was possible to get a concrete reservoir water-tight, except for a certain amount of seepage, which would be so small as to do no lasting harm to the structure in the course of its legitimate use. He says the actual results have fully justified this statement.

Reports of Gas Associations for 1906.—It will be seen, from an announcement which appears elsewhere, that this volume is now ready. It is an addition to the series of collected transactions of the District Associations of Gas Engineers and Managers commenced in 1883, and it contains the reports of the proceedings of these bodies in the past twelve months. In the volume for 1905, the newly-formed Institution for Wales and the Monmouthshire district was included; in the one just issued will be found the South-East of Ireland Association. The matter extends to 602 pages, compared with 588 and 482 pages respectively in the two immediately preceding volumes; and it is illustrated by two plates, 27 figures, and a number of diagrams. A list of these is given, as well as a general index to the contents. The reports are followed by lists of the officers and members of the several Associations. The volume is neatly bound in cloth, and presents, in a convenient shape for reference, the past year's work of the Provincial organizations of gas managers, as recorded in the "JOURNAL." It consequently forms a companion to the Transactions of the Institution of Gas Engineers.

THE RUMMENS SYSTEM OF VERTICAL RETORTS.

About this time last year, we described and illustrated an arrangement of vertical retorts by M. Rummens, of Brussels, by which he is able to produce simultaneously ordinary coal gas and carburetted water gas. M. Rummens has devoted considerable attention to this subject, believing as he does in the employment of every method of reducing the cost of gas manufacture to the lowest limit, so as to allow of the consumer being supplied as cheaply as possible. A short time ago, he attended a meeting of the section of the Brussels Chamber of Commerce dealing with public works and the application of science to the industries, and explained the construction of his furnace.

In the course of his introductory remarks, he directed attention to the close connection between the use of vertical retorts and the economical production of gas, and referred to the installations at Dessau and Mariendorf, and to the well-known labours of Dr. Bueb and Herr Drory. He said that Dr. Bueb's system, as originally introduced, was attended by certain inconveniences which had been criticized in England; but the results obtained at the two places named, with new settings which had no special arrangement for the lateral escape of the gas, were very satisfactory. The production of gas per ton of coal carbonized was rather higher than that obtained with ordinary settings, while the residuals were more abundant and of better quality. In his (the speaker's) opinion, Dr. Bueb had demonstrated the possibility of employing vertical retorts without having to fear the inconveniences which had caused them to be abandoned in the early days



Vertical Retorts on the Rummens System.

of the gas industry. But while these defects were less serious than had been supposed, they still existed; and he thought there was a way of avoiding them entirely by other arrangements than that of the side channel (so located as to be unaffected by the heat), which Dr. Bueb had devised, but which had not been successful.

At the close of his preliminary observations, M. Rummens proceeded to describe his system of setting vertical retorts, for which he has taken out patents in Belgium, France, England, Germany, and Austria. It is shown in the accompanying illustrations. He pointed out that in his setting the single side channel which Dr. Bueb had given up is replaced by a special arrangement consisting of double side walls for the retorts and of a single hollow mouthpiece surrounding them; the whole being so devised that at the commencement of carbonization the gas produced can escape sideways up the entire height of the retorts by means of openings made between the walls, and afterwards pass away by the central core of coal, when this is contracted as the result of the formation of a layer of coke at the periphery, which has produced therein apertures sufficiently large for the easy passage of the gas. This may escape during the entire period of carbonization without having to traverse a superheated layer of coal, which would cause the destruction of the light hydrocarbons constituting the most valuable properties of the gas from the point of view of its illuminating power.

The arrangement of furnace described by M. Rummens permits, as he claims, of economy being effected in the distillation of coal, inasmuch as vertical retorts lend themselves better than either horizontal or inclined ones to mechanical charging and to the easy removal of the coke. It dispenses with the separate installation of plant at present employed for the manufacture of water gas for mixing with the coal gas, by producing the former in the same retort as the latter, utilizing for the purpose the heat now lost in the incandescent coke drawn from the retorts. In this way a second reduction in net cost—not by mixing with the coal gas as large a quantity of water gas as possible, but by putting in only a limited quantity, obtained without expense, and mingled with the coal gas at a high temperature, as produced. The retorts are arranged side by side in one or two combustion chambers. They have a movable bottom and, as already stated, double side walls, the outer one of which is plain and vertical, while the inner one is perforated and widened towards the bottom so as to facilitate the discharge of the incandescent coke, and to allow a free space between the walls for the lateral escape of the gas, without having to pass through the mass of carbonized coal. Under each of the retorts is a closed chamber for the reception of the coke, furnished with a vaporizing apparatus for producing, by the injection of water, the steam necessary for making a limited quantity of water gas. Each vaporizer is composed of three concentric tubes surrounding a solid iron core; the tubes being separated

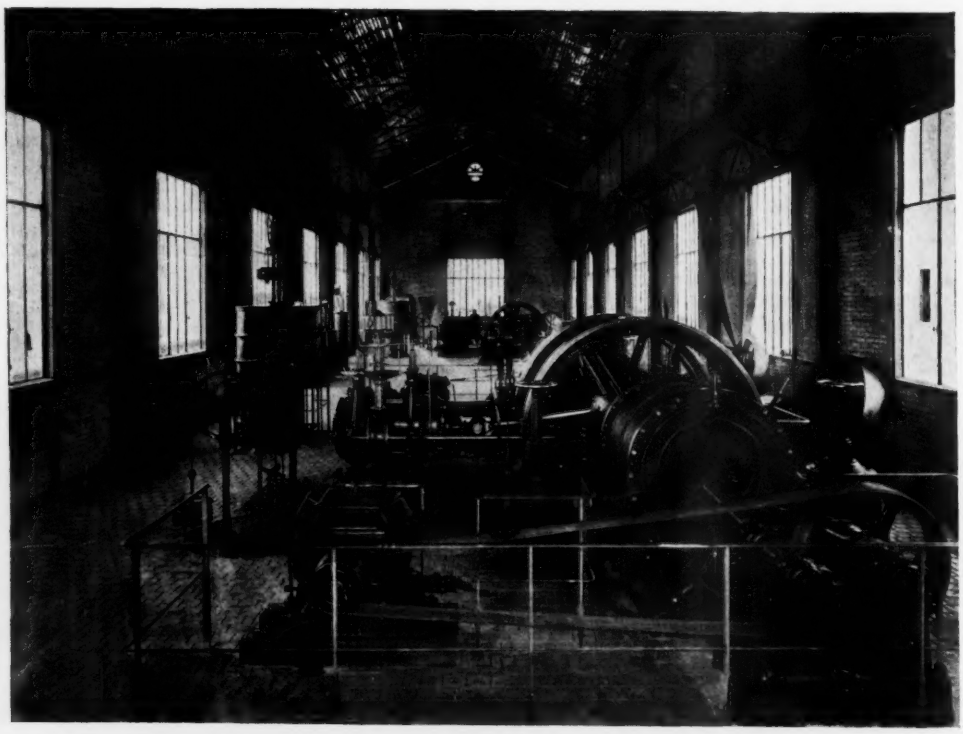
by small spaces into which is injected the water to be vaporized. The steam produced escapes by two horizontal pipes at the bottom of the apparatus, and is led directly into the retort, to be decomposed therein at a high temperature by the coal undergoing carbonization. Whatever may be the number of the retorts, they can be charged simultaneously and rapidly by the automatic charger with which the setting is furnished. It is provided with a number of receptacles which are alternately open and closed at the top and open at the bottom, and which, by a slight displacement, close or open the coal-hoppers located above each retort. While one charge is being worked off, the coal required for the next can be put into a hopper.

M. Rummens described, by means of diagrams, the various details of an experimental setting embodying the principles he enunciated, and explained its working. It only remained, he said, to demonstrate practically the value of his system by having the setting erected; and for this purpose the Communal Administration of St. Gilles had granted him a sum of 10,000 frs., for which he cordially thanked them. He was now seeking the means of testing his system on a working scale; and this would entail an expenditure of a larger amount than he had received. Moreover, it was indispensable that a gas-works should be placed at his disposal.

The President (M. Verstraeten) thanked M. Rummens for his interesting discourse, and wished him success in carrying out the trials which his system would have to undergo before its practical value could be determined. He thought a smaller setting than the one designed by M. Rummens, which was estimated to cost 30,000 frs., would be sufficient for a preliminary test; and the amount allocated would then be enough. Such a setting would be adequate to show the quality of the gas produced. M. Rummens said his impression was that the 10,000 frs. was intended as a contribution towards the expense of erecting a trial setting in accordance with the plans which he had exhibited; and this view of the position was subsequently confirmed by the Burgomaster of St. Gilles.

THE EXHAUSTING AND COMPRESSING PLANT AT THE GENNEVILLIERS GAS-WORKS.

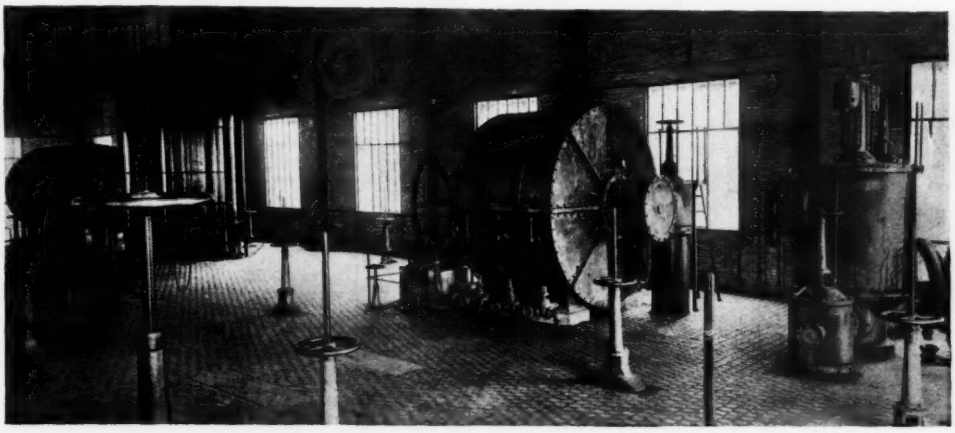
In a recent issue of the "JOURNAL" (*ante*, p. 87), we gave an account of the distributing plant laid down by the Société d'Eclairage, Chauffage, et Force Motrice for the supply of gas in the suburbs of Paris from their new works at Gennevilliers. It may be remembered that in addition to these works there are two gasholder stations—one at Boulogne-sur-Seine and the other at Alfortville—to which gas is conveyed by three mains ranging from 39 inches down to 20 inches in diameter. From the largest of



The Exhauster-Room.

The Governor-Room.

The Compressing-Plant.



Battery Condensers, Naphthalene Washers, Tubular Condensers, and Ammonia Washers.

these mains are taken the branches for the supply of the several communes; and at the junctions are placed the necessary governors for regulating the pressure. We to-day give a few particulars and illustrations of the exhausting and compressing plant.

The gas is sent from the principal works by three sets of two double exhausters (one kept as a stand-by), each driven by a steam-engine placed between them. The gas is drawn off the inlet-pipe to the holders at Gennevilliers in such a way that the variations of pressure do not cause repercussion on the distribution, and is carried forward by the smaller mains direct to the storage stations. The compressing plant includes a double-action relief regulator for diverting the current of gas in the scarcely probable event of the gasholders at Gennevilliers being right down, or the inlet-valves of those at Boulogne and Alfortville being closed by inadvertence. The latter holders can also be filled from the larger main; and with the view of avoiding too great a lowering of the pressure, there has been erected at each of the two stations named one of Beale's exhausters driven by a gas-engine furnished with an anti-fluctuator. It only remains to mention that the installation of the whole of the appliances just described was entrusted to the Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz of Paris, to whom we are indebted for the loan of the photographs from which our illustrations were prepared.

INVESTIGATIONS OF LIGHT-STANDARDS.

By Clifford C. Paterson.

Extracts from a Paper read before the Institution of Electrical Engineers last Thursday.

In the introductory lines of the paper, the author reminded the members that four years have elapsed since Dr. Fleming raised the question of photometry before the Institution, in a comprehensive paper on electric lamps. The communication dealt in a very thorough way with the general position of light standards in 1902; and Dr. Fleming pointed out the uncertainty which existed in photometric comparisons at the time, due in no small degree to the difficulty of reproducing light standards accurately, and also to uncertainties which existed as to their relative values. The object of the author in the present paper was to lay before the Institution, first of all the results of some investigations on flame standards made at the National Physical Laboratory, and afterwards to describe other tests, some of which were carried out on carbon filament lamps for the Engineering Standards Committee. [The extracts given here are confined to the former section of the paper.] The author expressed the hope that the data would be of value to the electrical and gas industries. The following portions of the paper are in the author's own words.

Comparison of Flame Standards.

The investigations referred to were undertaken two years ago at the instigation of the Institution of Gas Engineers, with the object of determining the ratio between the candle powers of the three principal standards as used by the gas industries at the present time in France, Germany, and Great Britain. The author desires to acknowledge the kindness of the Institution of Gas Engineers in allowing the publication, in this paper, of the main features of the report submitted to them eighteen months ago, and which they have only refrained from publishing earlier at the request of the International Photometric Commission.

This Commission, on which the Institution of Gas Engineers is represented, arranged for similar tests to be made in France and Germany, in order to obtain a set of independent comparisons which shall enable the ratios between these standards to be defined with more certainty and greater accuracy than at present. The results of tests in France and Germany, although completed more recently, have already been published; and a comparison of the figures is exceedingly interesting as showing the order of agreement which has been obtainable in the photometric measurements made by separate observers working under different conditions with different apparatus. A detailed comparison of the methods adopted in carrying out the tests cannot usefully be made until the full report of the Commission has been published; but the results of the tests in the various laboratories are tabulated and compared at the close of this section of the paper. The standards to which reference has been made are respectively the Carcel, the Hefner, and the 10-candle power Harcourt pentane lamps. In all measurements which are described here, special care has been taken in the manipulation of the lamps so as to conform to the regulations and practice observed in the countries in which they are the recognized standards.

Influence of Atmospheric Conditions.

It is now generally appreciated that atmospheric conditions have important influence on the candle power of flame standards. Dr. Liebenthal, at the Reichsanstalt, was the first to make quantitative measurements, in order to determine the amount of their influence on the candle power of lamps. He investigated two standards, the Hefner lamp and the Woodhouse and Rawson 1-candle pentane lamp, and the formulæ which he found for correcting the Hefner lamp are now generally accepted.

In a photometer room, the principal variations to which air is liable are the following: (1) Variation in the amount of carbon dioxide; (2) variation in the amount of water vapour; (3) variation in the proportion of oxygen and nitrogen; (4) changes in barometric pressure. Before any measurements with flame standards can be considered reliable, it must be ascertained that the air is under standard atmospheric conditions, at least as regards 2, 3, and 4. If the conditions be abnormal, the amount of water vapour in the air as well as the barometric pressure must be known.

In making measurements to determine the amount of candle-power variation due to any one of the above atmospheric changes, it is very difficult to artificially increase or decrease one without at the same time varying the others; and though attempts were made by the author to vary artificially the amounts of carbon dioxide and water vapour in the air, the results were difficult to interpret. The method was, therefore, discontinued in favour of the plan of waiting till the weather changed, and the desired conditions came in the ordinary course of events.

As these experiments must, in the nature of things, cover a considerable time, more extended investigations have been made by the author on the Harcourt 10-candle pentane lamp. This is the standard of the Metropolitan Gas Referees, and has been adopted at the National Physical Laboratory as being the most convenient unit of light; and the standard whose value is now most generally recognized as representing that of ten British parliamentary candles.

Carbon Dioxide.—In order to determine the effect, if any, of variations in the amount of carbon dioxide present in the air, samples of air were taken from the neighbourhood of the lamps while observations were being made. The air was slowly drawn into previously exhausted 10-litre vessels, which, when full, were tightly stoppered and examined at the end of the observations. The amount of carbon dioxide was determined by shaking up with barium hydrate and subsequent titration with oxalic acid. It was found that the normal variation of carbon dioxide in the air at Bushy House only covered a range of from 0·3 to 0·7 part

TABLE I.

Column 1. Hours after Lighting up.	Column 2. Candle Power of Pentane Lamp.	Column 3. CO_2 in Litres per Cubic Metre.	Column 4. Water Vapour in Litres per Cubic Metre of Pure Air.
0	10·06	0·55	9·0
¼	9·75	0·9	10 6
1¼	9·60	1·4	11·0
3¼	9·45	1·8	11·8
4¼	9·33	1·9	12·2

per thousand; and no candle-power difference was observable due to this amount of change. In order to increase the effect, the amount of carbon dioxide was artificially increased to 1·9 litres per thousand—the photometer room being closed, and candle-power readings taken over four hours. The results of such an experiment are given in Table I. After correcting for the increase of humidity, the decrease in candle power after 4¼ hours amounts to some 5 per cent., which is very little in excess of the observed decrease when the lamp is merely left burning in an ordinary closed room.

Dr. Liebenthal found, from experiments in which he artificially increased the amount of carbon dioxide to 14 litres per cubic metre, that the candle power of the Hefner lamp varied 0·7 per cent. for an increase of 1 litre per cubic metre. As the amount of carbon dioxide in a closed room, $5 \times 6\frac{1}{2} \times 4$ metres, in which the lamp has been burning for upwards of one hour, only varies from about 0·5 to 0·8 litre per thousand, the influence of carbon dioxide on the candle power of flame standards may be considered, for practical purposes, as negligible.

Water Vapour.—The amount of water vapour in the air is the most disturbing factor to be considered in dealing with flame standards, as it cannot be remedied by ventilation of the photometer room. There are large natural variations in humidity throughout the year, and rapid changes from day to day. For instance, the total variation in the candle power of the pentane lamp between a warm, damp day in summer and a frosty one in winter, may amount to 10 per cent.; and between two consecutive days, it is frequently 2 or 3 per cent.—the changes in the Hefner lamp from this cause being very little less than in the pentane.

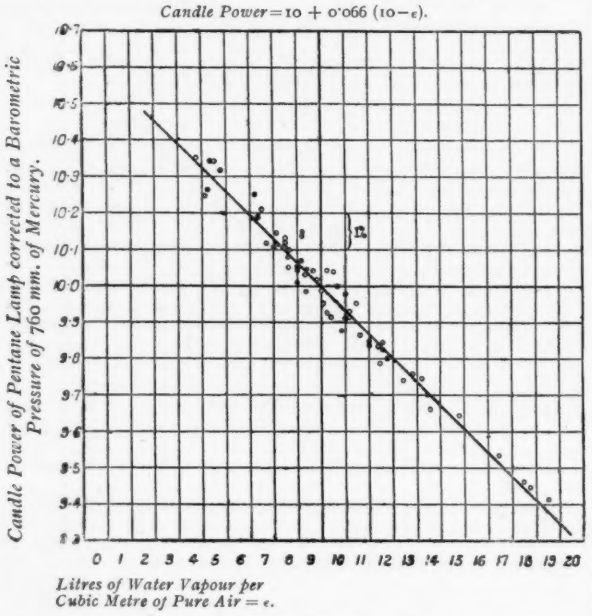

Candle Power = 10 + 0·066 (10 − ε).
Candle Power of Pentane Lamp corrected to a Barometric Pressure of 760 mm. of Mercury.
Litres of Water Vapour per Cubic Metre of Pure Air = ε.

Fig. 1.—10-Candle Harcourt Pentane Lamp—Variation of Candle Power due to Humidity.

A discussion of the various methods of measuring humidity is a subject which hardly comes within the scope of this paper. The chemical method, Dynes' dew-point hygrometer, the ordinary wet and dry bulbs, and the Assmann ventilated wet and dry bulb thermometers have all been used. The last-mentioned instrument has been found to give the most reliable and consistent readings, as well as being the easiest to manipulate. The author reproduces a curve which he published in his paper read before the British Association in 1904*, showing the effect of variations in the humidity of the atmosphere on the candle power of the pentane lamp; the candle power being plotted vertically, and humidity horizontally. The latter, for obvious reasons, is stated volumetrically, and is expressed as the number of litres of water vapour per cubic metre of dry air. If, therefore, e stands for the aqueous pressure, then the water vapour per cubic metre of pure air

$$= \frac{e}{b - e} \times 1000 \text{ litres},$$

* See "JOURNAL," Vol. LXXXVII., p. 605.

where b is the reading of the barometer. Each point on the curve is the mean of a set of observations. None of the atmospheric conditions were artificially produced; but the results were obtained by observations taken under normal conditions throughout the year. These show, therefore, the kind of candle-power variations which may be expected when using the lamp under favourable conditions—amounting to a possible error, due to humidity alone, of *plus* or *minus* 5 per cent.

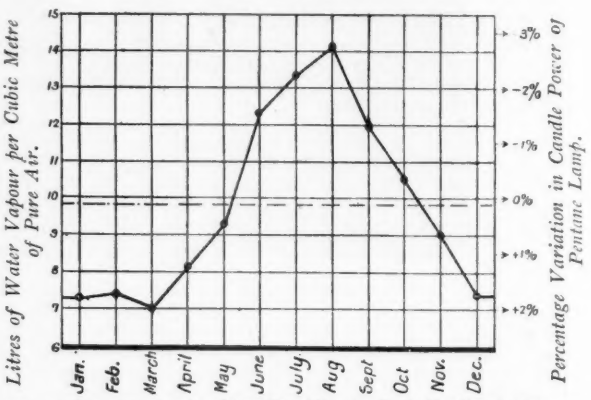

Litres of Water Vapour per Cubic Metre of Pure Air.
Percentage Variation in Candle Power of Pentane Lamp.
Jan. Feb. March April May June July Aug Sept Oct Nov. Dec.

Fig. 2.—Diagram showing Mean Humidity for Each Month of the Year.

The curve has been obtained from the barometer and humidity readings by the method of least squares. On the assumption that the variations follow straight-line laws, the following formula is obtained, connecting candle power and humidity for the 10-candle lamp:—

$$\text{Candle power} = 10 - 0{\cdot}066\ (10 - \epsilon)$$

where ϵ is the number of litres of water vapour per cubic metre of dry air.

It will be observed from this formula that the candle power of the lamp has its standard value when the volume of water vapour is 10 litres. This figure has been taken as representing very nearly indeed the mean humidity over the three years 1897–8 and 9, both at the Meteorological Office in Victoria Street and at the Observatory Department of the National Physical Laboratory. The former gives a mean of 10·04 litres per cubic metre, and the latter 9·85 litres.

The curve in fig. 2 shows the mean humidity over three years for each month of the year as found at the Observatory. Humidities are plotted as ordinates on the left-hand side, and percentage variation in candle power on the right. It will be seen from this that the average monthly humidities range from 7 to 14, corresponding to errors of about *plus* or *minus* 2 per cent. in candle power. As already observed, however, individual observations are liable to twice this error.

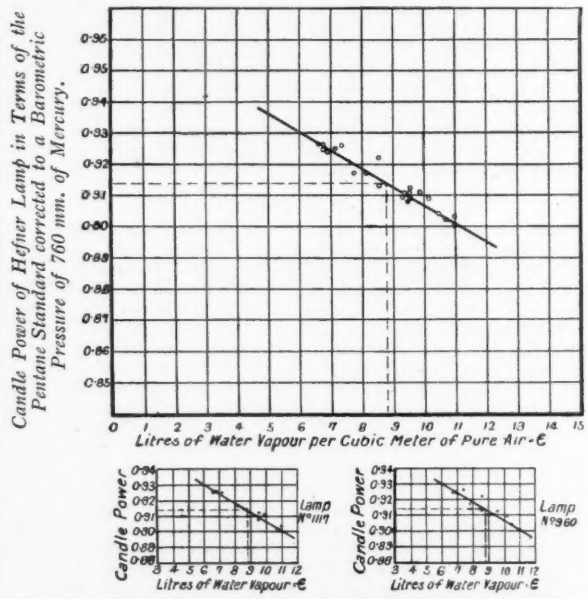

Candle Power of Hefner Lamp in Terms of the Pentane Standard corrected to a Barometric Pressure of 760 mm. of Mercury.
Litres of Water Vapour per Cubic Meter of Pure Air-ε
Candle Power
Lamp No 1119
Lamp No 960
Litres of Water Vapour-ε

Fig. 3.—Hefner Lamp—Variation of Candle Power due to Humidity.

Fig. 3 gives a curve similar to that shown in fig. 1, but obtained for the Hefner lamp. Its candle power is expressed, for the sake of comparison, in terms of the pentane lamp burning in an atmosphere containing 10 litres of water vapour per cubic metre of pure air. Two lamps previously certified by the Reichsanstalt (the German Standards Laboratory) were used in the experiments; the observations on the individual lamps being shown separately by the side of the main diagram, in which all points

have been plotted. The formula obtained from these observations is—

Candle power (pentane units) = 0·914 + 0·006 (8·8 − ϵ).

Dr. Liebenthal, from the average of a much larger number of observations made over a greater range of humidity, found a formula which, using the ratio of Hefner to pentane as 0·914, gives the following relation:—

Candle power (pentane units) = 0·914 + 0·005 (8·8 − ϵ).

As this is based on more numerous data, it should be accepted in preference to that given by the author for the Hefner lamp. It may be noted, however, that the difference between the two formulæ produces a discrepancy of under 1 per cent. in candle power even for an extreme case.

As all the observations were made in the neighbourhood of 8·8 litres of moisture (which is the humidity fixed by the Reichsanstalt at which the lamp shall be taken as giving 1 Hefner candle), the exact value of the humidity constant will not affect the accuracy of the ratio found for the candle power of the two standards.

A similar set of experiments was made with two Carcel lamps; but the want of constancy in the lamps themselves, introduced inconsistencies into the results which were of a greater order of magnitude than the largest change produced by such range of humidity as was obtainable at the time of the year. The results of the tests have been plotted in fig. 4 in order to obtain a graphical comparison with the tests on the other lamps. They show that the Carcel lamp cannot be relied upon for constancy to the same extent as the other lamps. It will be seen, however, by the diagrams on the right-hand side of the figure, that the average candle power of one Carcel lamp is in very close agreement with the average candle power of the other.

The Proportion of Oxygen and Nitrogen in the Air.—The author is not aware that any quantitative measurements have yet been made on the diminution of candle power due to a scarcity of oxygen in the photometer room. Dr. Liebenthal discusses the matter on theoretical grounds, and calculates that a decrease or increase of 1 per cent. in atmospheric oxygen should make a difference of 4 per cent. in candle power. It has been remarked by most experimenters with flame standards—especially with a large unit like the 10-candle pentane lamp—that the candle power rapidly falls off in a closed room, and that this reduction cannot be accounted for by the increase of water vapour or carbon dioxide in the air. The author has made measurements in a closed room of 130 cubic metres capacity, and finds that the candle power of the pentane lamp falls about 1 to 1½ per cent. in 1 hour.

Mr. Dow has recently published some curves* showing results of tests made at Kensington in a room of about 400 cubic metres capacity, in which, with two persons in the room and two gas-burners alight, the candle power dropped some 2·5 per cent. in 1 hour. In a small, closed photometer room in which no effort is made to ventilate, a variation of from 7 to 10 per cent. may quite possibly be obtained. With a small unit such as the Hefner lamp, the trouble due to this cause is not so great; but it may safely be said that, under no circumstances, is it safe to use a flame standard in a room which has not very efficient ventilation.

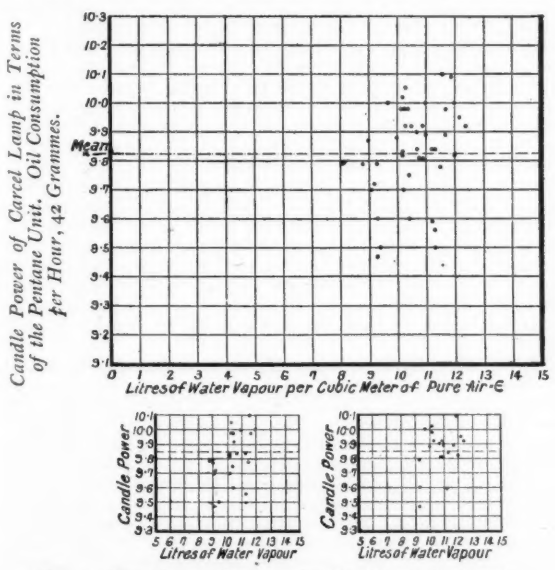

Candle Power of Carcel Lamp in Terms of the Pentane Unit. Oil Consumption per Hour, 42 Grammes.
Mean
Litres of Water Vapour per Cubic Meter of Pure Air-E
Candle Power
Litres of Water Vapour
Candle Power
Litres of Water Vapour

Fig. 4.—Carcel Lamp—Diagram Showing Observations made.

In the case of a 10-candle-power pentane lamp, no measurements should be relied upon which have been made after the lamp has been burning in a closed room for more than fifteen or twenty minutes, unless, of course, the source of light which is being measured is affected in the same way by atmospheric changes. The author proposes to make some tests on flame standards in the near future, measuring at the same time the amount of oxygen in the air, with the object of determining if the diminution observed in their candle power, as explained above, may be attributed to this cause. The experiments would have to be made in a small, closed room into which oxygen can be introduced in large quantities.

These facts illustrate how misleading may be the results obtained from comparisons made against a flame standard unless proper precautions are taken and the necessary corrections applied. Suppose, for instance, that the lamp is being used in a room in which the ventilation is bad, and causes (say) a drop of 1·5 per cent. in the candle power of the lamp. If the day be hot and damp, and the barometer low, the 10-candle lamp will be giving a light of the order of 9·2 candles; and the Hefner lamp under the same conditions will be only slightly more accurate.

Barometric Pressure.—Under normal conditions, the amount of variation due to this cause does not give rise to such large errors as changes in humidity. With a high barometer, the candle power tends to rise; but the amount of the increase or decrease varies considerably with the type of flame—being 0·8 per cent. per 10 mm. variation in barometric pressure for the 10-candle pentane lamp, and (according to Dr. Liebenthal) 0·1 per cent. for the same variation in the case of the Hefner unit. The author has found 0·2 per cent. in the latter case, while Dr. Liebenthal finds 0·6 per cent. in the former. The same authority has found 0·4 per cent. in the case of the 1-candle pentane flame.

The formulæ which are most probably correct for expressing candle-power variations due to barometric changes are—

Pentane lamp: Candle power = 10 − 0·008 (760 − b).
Hefner lamp: Candle power = 0·914 − 0·0001 (760 − b).
(Pentane Units.)

Photometric Methods.

The foregoing notes on the variation of standards with changing atmospheric conditions make it clear that it is not sufficient, in comparing any two flame standards of different types, to fix them up on the bench and measure the ratio of their candle powers, without regard to the state of the air, on the assumption that they will both be affected equally by it. Unless the atmospheric conditions at the time of observation happen to be standard, or very nearly standard, it will be necessary to make a series of candle power comparisons with hygrometric and barometric readings. A formula has then to be deduced from which the candle power, under standard conditions, may be found.

The method of comparing two flame standards by fixing them both on a bench together, and obtaining points of balance between them, is not to be recommended, especially when the ratio between them is of the order of 1 to 10, as it is in the case of the Hefner and pentane lamps. The method entails a change over of the lamps to opposite ends of the bench, a maximum difference of colour in the photometer, and the simultaneous regulation of the height of the two flames—which is a troublesome operation. The double comparison, or substitution method, fully described by Dr. Fleming in the paper already mentioned, is much to be preferred. By this method, a constant source of light (such as an electric lamp) is fixed at one end of the bench, and the two flame standards to be compared are alternately measured against it. In the tests described in this paper, each flame lamp was compared through the medium of an electric comparison lamp of suitable colour against the large bulb electric standards which now form the principal working standards of the Laboratory. The method has the following advantages:—

(*a*) Only one flame lamp has to be regulated at a time;
(*b*) Personal and bench errors are eliminated;
(*c*) A set of observations is obtained from which the relations between candle power and atmospheric conditions can be deduced for each lamp.

Lamps and Criticism.

The Ten-Candle Harcourt Pentane Lamp.—Having briefly described this lamp, the author remarked that, as far as he is aware, the extent to which a variation in the dimension of any part of the lamp affects its candle power has not yet been determined. Some points in the lamp are, of course, much more sensitive than others; and the author has on hand at the present time a set of experiments on a special lamp, by which it is hoped to ascertain the most important points in its construction, and the amount to which a given increase or decrease of the dimension of any part will affect the candle power.

The Metropolitan Gas Referees state in their notification that in regulating the height of the flame to about midway between the bottom of the window and the bar which crosses it, a variation of a quarter of an inch either way does not materially affect the candle power of the standard. This statement may be accepted, provided the accuracy required is not greater than about 1 per cent. If, however, measurements are to be within this limit of accuracy, it is essential that the flame shall be kept at the right height. Dr. Liebenthal finds that the flame may rise above the mark, but not fall below it. The author's experiments, however, confirm those of other observers, in showing that Mr. Harcourt has so proportioned the dimensions of the lamp that, when the flame is at its correct height, its candle power is a maximum—any variation above or below the normal height causing a decrease in candle power. This is a point which is greatly in favour of the lamp, as it means that a certain variation of height is possible, within

* See "Journal," Vol. XCVI., p. 20.

which it is quite easy to regulate the flame, and within which the candle power does not perceptibly vary. By affixing a piece of rubber tube to the air-inlet cock on the saturator, and regulating the flow of air through it by an ordinary screw clip, a most sensitive means of flame adjustment is obtained. The observer also is able to stand at such a distance from the lamp that he will not disturb the steadiness of the flame through air currents set up by breathing near it. From this point of view, the lamp compares favourably with the Hefner standard, the flame adjustment of which, in spite of the ingenious optical device used, is a matter requiring great patience and entailing some uncertainty.

The procedure which the author has found it desirable to adopt when using the standard is as follows: The lamp is set up plumb at the end of the bench by means of a plumb-line passed through the chimney, and made to coincide with its central axis by means of a centring plug at the top. The lamp is then levelled till the plumb-bob hangs exactly over the middle of the burner. A gauge of the same pattern as that employed by the Gas Referees is then used to measure the distance of the lamp from the photometer. It has a pin at one end which exactly fits the centre of the burner, and a shoe at the other end, the tip of which must graze some known point on the photometer (either the screen or some portion of the box which is a definite distance from it). The lamp is lighted up and all doors and windows of the room are thrown open. The lamp is allowed to burn this way with free circulation of air for half an hour. The electric comparison lamp is then brought up to its correct voltage by the potentiometer, and all windows and doors closed before taking readings.

The author has not as yet found any photometer which, for the same coloured light, is equal in sensitiveness and accuracy to the Lummer-Brodhun contrast apparatus, which was used in all the experiments described in the paper. Some twelve or fourteen readings are made during the first ten minutes after the room has been closed, together with observations on both ventilated and unventilated hygrometers placed at different points in the neighbourhood of the lamp. It is desirable for one of the observers to remain at the photometer and on no account to see the position of his own settings, while another adjusts the flame and takes down readings.

As regards the accuracy of photometric observations made under these conditions, much depends upon the condition of sensitiveness of the observer's eye on any particular occasion. This is certainly a variable quantity. The author has found on some occasions that ten readings will agree among themselves to within *plus* or *minus* a quarter of 1 per cent.; while on others the extremes are occasionally as much as *plus* or *minus* 1 per cent. A set of ten observations taken at random from a test-book shows the following values for the pentane lamp in terms of the National Physical Laboratory Standard Electric Lamps, and illustrates the kind of individual variations to be looked for in such measurements:—

$9{\cdot}81_5$, $9{\cdot}81_5$, $9{\cdot}87_0$, 9·90, 9·90, 9·85, $9{\cdot}87_8$, $9{\cdot}87_8$, 9·85, $9{\cdot}83_8$, $9{\cdot}86_7$.

The humidity on this occasion was 12·4, and the barometric pressure 762 mm.

The Hefner Lamp.—Having described this lamp, the author stated that the general precautions to be observed as regards ventilation when using the lamp are the same as for the pentane standard, except that the room may be closed somewhat longer while readings are in progress before the candle power of the lamp shows signs of diminution. Considerable care and skill must be employed in judging whether the flame is at its correct height. The author has observed a tendency for the flame to vary its shape from one which is high and pointed, to one which is somewhat depressed and flattened at the top, and an error in candle power may result from taking either of these as correct, and adjusting either the pointed or the flattened flame to the level of the cross line.

The Carcel Lamp.—This lamp was described; and in further references the author said he has found that, after taking a large number of observations, and using the utmost care in all the adjustments, he has been unable to make readings from the lamp agree with certainty to within an accuracy of + or − 3 per cent. In any two directions at right angles, the light from the flame may vary by as much as 2 per cent.; and to ensure even the 3 per cent. limit of accuracy, it is generally necessary to take a mean of four readings round the flame in directions at right angles to each other in a horizontal plane.

Summary of Results.

In summarizing the results of the tests described, and comparing them with those made in laboratories on the Continent, it is essential to take into consideration the fact that the Hefner lamp in Germany has its standard value when the volume of water vapour is 8·8 litres per 1000 litres of air; whereas both the pentane and Carcel lamps are taken as having their nominal value when the humidity is 10 litres per 1000.

The following values are obtained for the Hefner and Carcel lamps from the curves given in figs. 1, 3, and 4. These values are in the terms of the 10-candle Harcourt pentane lamp. In the case of the Carcel standard, the mean of all the readings shown in fig. 4 has been taken. The variations of the Carcel lamp with changing humidity will hardly concern these figures, since all measurements were made in the neighbourhood of 10 litres per 1000.

Hefner lamp = 0·914 pentane units.
Carcel lamp = 0·982 pentane units.

The following tables give the values for the same ratio recently obtained and published by the Reichsanstalt in Berlin, and by the Laboratoire Centrale d'Electricité and the Laboratoire d'Essais et Conservatoire in Paris.*

Expressing the values of all the units in terms of that given by the pentane lamp, we have—

	Pentane.	Hefner.	Carcel.
National Physical Laboratory	1	0·914	0·982
Reichsanstalt	1	0·917	0·991
Laboratoire Centrale	1	0 929	1·000
Laboratoire d'Essais	1	0·928	0·996

Expressed in terms of the unit given by the Hefner lamp they are as follows—

	Pentane.	Hefner.	Carcel.
National Physical Laboratory	1·094	1	1·074
Reichsanstalt	1·090	1	1 080
Laboratoire Centrale	1·076	1	1·076
Laboratoire d'Essais	1·077	1	1·067

Expressed in terms of the unit given by the Carcel lamp—

	Pentane.	Hefner.	Carcel.
National Physical Laboratory	1·018	0·931	1
Reichsanstalt	1·009	0·926	1
Laboratoire Centrale	1·000	0·929	1
Laboratoire d'Essais	1·004	0·937	1

These results show that, in entirely independent comparisons of flame standards in Paris, Berlin, and London, the maximum difference between London and Berlin was 1 per cent.; between Paris and Berlin 1·7 per cent.; and between London and Paris 2·1 per cent. It should further be remarked that the discrepancies may to some extent be accounted for, leaving a smaller residual error to be attributed to unexplained causes.

Comparison and Criticism of the Three Lamps as Standards of Light.

The measurements made at the National Physical Laboratory on the three principal flame standards now in use have given opportunities for comparing them under working conditions and judging of their respective suitability as standards of light.

As regards the Carcel lamp, it has not been found that its constancy from day to day is comparable with that of either the Hefner or pentane lamp; its variations from the mean being as much as + or − 3 per cent. The reason for this can only be attributed to the difficulty in reproducing the same conditions of capillarity in the wicks used. Although all possible care was taken to produce the most favourable conditions of constancy, the results were not satisfactory, and in the notes which follow, the pentane and Hefner lamps only are considered with reference to their suitability as light standards.

General Construction.—The Hefner lamp, which is only one-eleventh the candle power of the pentane lamp, is much simpler in general construction, small and more easily set up, and should be simpler to manufacture and adjust to standard dimensions.

Ease of Regulation and Working.—It has been found in using the lamp that the flame of the 10-candle pentane standard is a great deal easier to adjust, and remains more constant while observations are being made than the amyl-acetate lamp.

The fact that the Hefner unit has a lambent flame, burning in free air, whereas the pentane standard is well shielded and, owing to its chimney, has a more stable flame, makes the latter practically independent of draughts which would render measurements with the Hefner lamp quite impossible. Although the flame of the Hefner lamp may be shielded, slight movements of the air cannot be avoided. These disturb the flame so that it only remains at its correct height for a few seconds—rendering adjustment difficult and the taking of candle-power readings rather a tiring process. On the other hand, it is not safe to assume that, owing to the fact that the top of the flame of the pentane lamp is cut off, the latter may be allowed to vary appreciably in height. Variations of 3 mm. up or down do not materially affect the candle power, but for accurate work a second observer is required in order to see that the top of the flame is flat, and to regulate it to the correct height.

Effect of Atmospheric Changes.—As regards changing humidity, the two standards are affected to nearly the same extent; the Hefner lamp being slightly less influenced than the pentane lamp. The latter standard, however, is very much more sensitive to barometric variations than the Hefner unit—a 1-inch change in pressure being equivalent to 2 per cent. in candle power.

Nature of the Light.—The pentane lamp has a whiter light than the Hefner unit, being much more nearly the same tint as the Carcel standard. The fact that its candle power is eleven times that of the amyl-acetate lamp makes it of the same order of magnitude as the ordinary lights which are tested against it. These two factors, coupled with the greater ease of adjustment when making observations with the pentane lamp, greatly outweigh, in the author's opinion, the disadvantage of the more complicated construction and the larger correction that has to be applied for changes in barometric pressure.

* The values for the three ratios given by the Laboratoire d'Essais differ among themselves by about 1 per cent. The mean values have therefore been taken.

Secondary Standards of Light.

Under this section the author gives the results of tests made at the National Physical Laboratory on a number of high-voltage standard electric lamps. The tests were undertaken to ascertain what order of constancy may be expected from the best high-voltage glow-lamps, with a view to using them as photometric standards. The first point which is evident from an inspection of the curves presented by the author is, that the performance of filaments specially prepared for constancy cannot be predicted with certainty. If a lamp is to be used as a photometric standard of the first grade, its history for 100 to 200 hours should be known, and its life curve should be closely watched in order to ascertain the point at which it is beginning to flatten out. If the only photometric standards required were of the low-voltage type, the problem might be considered as solved. A properly aged specially prepared low-voltage filament if burnt for (say) ten minutes a day for five days a week should last two or three years without changing the half of 1 per cent. in candle power, provided that no excess voltage is applied. Where, however, the only source of supply is a high-voltage variable circuit, it is essential that the standard and the test lamp shall be run in parallel, so that the effect of voltage variations may be reduced to a minimum. This entails either the use of a low-voltage lamp with a fixed resistance in series, or a high-voltage lamp of reasonable constancy.

In the tests under consideration six lamp makers kindly undertook to co-operate with the laboratory in the investigations, by supplying high-voltage 16-candle-power lamps, with filaments which they considered would be most suitable for standard purposes. The filaments were in one plane and the bulbs of ample dimensions. The lamps numbered in all thirty-seven, and were run on a pressure-regulated circuit with frequent observations of candle power and current.

The average rate of fall in candle power for each make of lamp is given in Table II., as well as its average efficiency. The figures in the fourth column are taken from the portion of the curve at which the rate of fall is most even.

Table II.

Make of Lamp.	Number Tested.	Average Initial Watts per Candle.	Column 4. Percentage Fall in Candle Power per 100 Hours.
A	5	3·4	4·6
B	4	4·2	0·9
C	3	4·1	1·7
D	8	4·0	3·7
E	11	4·5	2·9
F	6	3·7	3·5

As a result of these investigations, there is no doubt that high-voltage lamps are to be obtained which remain constant for a considerable time. They cannot, however, as yet be produced with certainty. By trying a number of special lamps, some may be found which are in every way as good as low-voltage standards; but at present the only alternative to this is to select a lamp with as small and as regular a drop as possible, and rely on restandardization after about twenty hours' running. It should not be necessary to run a standard under ordinary conditions for longer than forty-five minutes per week in all. In this case restandardization would only be required every six months.

Commercial Glow-Lamp Testing.

In the next section of the paper, which was of considerable length, the author emphasized the need for a closer supervision of the electric glow lamps which in the ordinary course of business are supplied to purchasers in this country. Lamps which are otherwise good are classed for use on voltages for which they are unsuited, and either give out early or have a long and inefficient life. On the other hand, many lamps are sold which, although of average efficiency, drop within a comparatively short time to 80 per cent. of their original candle power. It is noteworthy that although the greatest effort is often made to obtain the last ½ per cent. efficiency in the machinery generating the lighting current, often under severe penalties to the maker, an inefficiency of 20 per cent. or more in the glow lamp (the last link of transformation) is allowed to pass altogether unheeded and unchecked. It is surely in the best interests of the supply companies that the consumer should get the best value for his money. In the specification of the Sub-Committee on Physical Standards of the Engineering Standards Committee, published this winter,* rules are laid down for the inspection and testing of samples from consignments of glow lamps with the object of determining whether the delivery from which they were taken comes up to the specification.

The Engineering Standards Committee have given the author permission to publish the results of some tests which have been carried out for them at the National Physical Laboratory on 120 high-voltage glow lamps. These were made by ten British makers, and were bought over the counter in the ordinary way. The extreme values of candle power, watts per candle, and life for each batch are given in Table III. It must be admitted that these wide variations leave much to be desired.

* See "Electric Lighting Memoranda" last week, p. 205.

Table III.

Make of Lamp.	Mean Horizontal Candle Power (Extreme Values).	Watts per Candle Power (Extreme Values).	Probable Life.
Batch			Hours.
1	16·1 to 21·5	3·04 to 3·75	43 to 130
2	13·1 to 14·8	3·83 to 4·19	340 to 650
3	15·2 to 17·8	3·56 to 3·90	330 to 660
4	14·1 to 17·0	3·72 to 4·26	470 to 1040
5	12·9 to 20·4	3·15 to 5·02	76 to 1170
6	12·1 to 18·4	3·29 to 4·65	136 to 1120
7	11·0 to 18·2	3·44 to 5·21	230 to 2500
8	15·3 to 19·4	3·12 to 3·76	180 to 540
9	13·0 to 16·1	3·33 to 4·25	190 to 790
10	13·1 to 18·6	3·24 to 4·28	160 to 820

It is rightly urged in extenuation of this condition of things, that the very unequal grading of supply voltages in this country renders it impossible for makers to supply lamps at a reasonable price which shall fall within the same narrow limits that are imposed under the American system. It is not possible in lamp manufacture to predict, even within fairly wide limits, what will be the voltage at which a lamp will give a certain candle power and consume a specified number of watts per candle. There must, therefore, of necessity be a considerable number of lamps which would be more suitable for, say, 215, and others for 225 volts, which are, nevertheless, rated for 220 volts, because of the small demand for lamps for the odd pressures, and the natural desire to keep down the number of outfalls to a minimum. But even taking this into consideration, the fact that some of the English makers are able to turn out a much more uniform product than others, shows that improvement would be possible if the large buyers of lamps insisted on having them supplied to specification, and took proper steps to see that they did not fall short of the guarantees.

Regarding the life test of individual lamps, the useful life obtained from the different groups varied between the limits of 150 and 550 hours.

If there are enough lamps to choose from, it may be possible to find some which have their standard efficiency at the marked voltage; but it must be remembered that great accuracy is required in the watts per candle, as 1 per cent. above or below the mean will cause a 5 per cent. error in the life.

Towards the close of the paper the author referred to the vital importance of good voltage regulation.

The Importance of Accuracy.

In conclusion, the author wishes to emphasize the importance both of accurate photometry and accurate electrical adjustments in connection with the rating and testing of glow lamps. The specification recently issued by the Engineering Standards Committee provides a sound basis upon which glow lamps may be bought and tested; but it is essential, in view of the sensitiveness of the glow lamp to small changes in pressure, that all measurements under it shall be conducted with a maximum degree of accuracy.

The waste of money per annum in this country due to using unsuitable lamps must be very great; and the only way to stop the waste is to encourage those manufacturers who rate their lamps properly and who give an effective guarantee of their quality. It should further be noted that, in order to obtain all the advantages accruing from the accurate rating of glow lamps, it is essential that supply engineers should regulate the voltage at the consumers' terminals within the narrowest possible limits.

In connection with these tests, the author specially acknowledges the obligation he is under to Dr. Glazebrook, Director of the National Physical Laboratory, and to other members of the laboratory staff for counsel and help.

Points from the Discussion.

The President (Dr. R. T. Glazebrook, Director of the National Physical Laboratory) said he thought the members were all very grateful to Mr. Paterson for the admirable manner in which he had put the paper before them. The author had alluded to the earlier work of Dr. Fleming; and he was glad they had him with them that evening. Perhaps he would open the discussion.

Dr. J. A. Fleming (London) remarked that Mr. Paterson had placed the members under great obligation by bringing before them the results of these long and careful tests at the National Physical Laboratory. Nowhere else could such a series of tests have been carried out. In any laboratory where the principal work was either commercial or consultative, it would be impossible to carry out such work as Mr. Paterson had described. He had given them an exceedingly full and valuable account of the behaviour of flame standards; and he had heaped proof upon proof that some of the statements were true that he (Dr. Fleming) made four years ago as to the variability of flame standards, and the immense effect exercised upon their light by moisture, carbonic acid, and especially by want of ventilation in the room where they were used. The results that Mr. Paterson had brought before them explained many of the difficulties that were found some time back in electric lamp photometry. Of course, the gas people had never discovered these vagaries of the flame standards, because they were simply engaged in testing one flame standard against another flame; and therefore they did not learn what

was going on with one or the other. He had noticed in going into photometer-rooms, the want of ventilation in them. Electric lamp photometry, however, had fostered attention to the behaviour of the flame standards; and that gas photometry never did. One thing that had not been fully explained was the variation that was caused in flame standards by a number of persons being in a photometer-room. It was not to be accounted for by an excess of moisture or carbonic acid. He had known, in a small photometer gallery, if three or four persons were present, there would be a marked variation in the flame standard; but, when the room was ventilated, the light of the flame standard would be restored. It was on account of these difficulties that he went into the question of the use of large bulb secondary standards. He found that the decay in the candle power of the lamp was largely, if not altogether, due to the deposit of carbon upon the glass. It therefore stood to reason that the larger they could have the glass, the less would be the obscuration in a given time of usage. He believed the large bulb standard on that account—provided it could be properly aged to begin with—would give them a less variable standard than would be afforded by a flame lamp subject to variations of atmospherical conditions. Regarding the ratio between the Hefner unit and the pentane unit, the author had given it as 0·914. He (Dr. Fleming) had sent three large bulb lamps to the Reichsanstalt in Berlin, to be tested. On their return, they were forwarded to the National Physical Laboratory and tested by the pentane standard. The ratios of the National Physical Laboratory to the Berlin measurement, given in Hefner units, was 0·888, 0·882, 0·885. This was very close, and showed that the ratio of the candle power of the lamps was practically the same. He had not been able to ascertain the reason for this; but perhaps Mr. Paterson could explain. If they took the Berlin measurements, in Hefner units, and reduced them to pentane units, they would find a difference of about 3 per cent. between the Berlin and the pentane measurements.

Mr. C. J. ROBERTSON (London) said, in view of the unreliability of flame standards, he thought that, in the carbon glow lamps as recommended by Dr. Fleming, manufacturers of such lamps had the means of obtaining accuracy in testing to such a point that it would be ridiculous for them to trouble to go further. One of the lessons of the tests was as to the great advantage that would accrue if the filaments could be put into larger bulbs for general use. There was great competition not only in the price of carbon filament lamps, but in their quality. The fact remained, however, that, so long as circuits were so very variable, lamp specifications would not do any more good than to give more uniform lamps. Before a lamp specification could be of any great value, there should be a specification of pressures. [Laughter.]

Mr. ALEX. RUSSELL thought the tests in the paper showed that the Carcel lamp was a very good one, considering the period at which it was invented. It was invented before Murdoch's candle [Laughter], and was practically the same as the Harcourt pentane standard. Mr. Paterson in his paper dwelt upon the importance of measuring the mean spherical candle power of glow lamps. It had been admitted for many years that the method of measuring mean horizontal candle power was both unscientific and inequitable.

Mr. LANCELOT W. WILD (London) referred to the large amount of work that was represented in the paper. With regard to the pentane lamp, Mr. Paterson had determined the effect of humidity and of carbonic acid upon the flame; and he had now promised to look into the question of the effect of the amount of oxygen in the air. He (Mr. Wild) would suggest that he should also look into the effect of the dimensions of the photometer-room, more especially the height. He believed the height of the room had a material effect upon the chimney draft. In preparing some tests which he had carried out with considerable care, and which were checked by Mr. Paterson at the National Physical Laboratory, he found that his pentane lamp, after all allowances had been made, gave 4½ per cent. less candle power than the one at Teddington. He put this down to the fact that his photometer-room was not so lofty as that at the National Physical Laboratory, or else that there was less oxygen in the air at Westminster than at Bushey Park. [Laughter.]

Mr. H. T. HARRISON (London) considered the paper had put another nail in the coffin of flame standards. In the printed copy of the paper, it took nineteen pages to show the troubles of flame standards; and, at the end, one came to the conclusion that they could only be used by a person who had everything at his fingers' ends that was necessary to keep the standards in a right condition. It practically came to this, that one could hardly breathe in a photometer-room without affecting the flame standard in some way or other. The recent paper on metallic filament lamps by Mr. James Swinburne gave them a little more hope, because the fact that metals could be used for lamp filaments would probably result in a standard of light which would be definite, and which could be worked under conditions that would result in a standard candle power. For instance, there was platinum. Mr. Swinburne said that chemists had been able to prove it was a ductile metal. They could draw the wire to a given length, section, and resistance; and, with a given current, it would afford a given light. In a short time now, he hoped they would be able to define a standard of light which was produced by passing a given current through a specific metal of given length and of given area.

The further discussion of the paper was adjourned.

SCOTTISH JUNIOR GAS ASSOCIATION.

The Western District Section at the Bonnyside Fire-Brick Works.

On Saturday afternoon, the members of the Western District Section of the Scottish Junior Gas Association paid a visit to the fire-brick works at Bonnybridge, belonging to Messrs. James Dougall and Sons, Limited. The party, numbering fifty, arrived at half-past two, and were received by Mr. J. Dougall and Mr. E. M. Stewart, the Manager, and others. Having been divided into groups, they were conducted by Mr. A. M'Neil (the Underground Manager), Mr. T. Wishart, Mr. R. Finlayson, Mr. T. Black, Mr. J. Stewart, and Mr. J. Cochran, round the works, which are very extensive, and down into the pit from which the clay is obtained. The work of making the many-sized and many-shaped brick pieces was shown in operation; and the working of the kilns was explained. There are numerous up and down draught kilns; and a large square kiln, of fourteen chambers, which is fired by gas, made in a couple of producers, and is worked as a continuous kiln, the heat given off by a chamber in process of cooling being employed to heat the air before its admixture with the gas below the combustion chamber. The Company have recently started the making of gas-retorts, and these were seen in various stages of manufacture. The clayfield extends to 500 acres, and contains a seam of clay—ganister and black clay—of great thickness. On arriving at the bottom of the shaft, the party had a walk of some 600 yards, through a spacious gallery, from 15 to 18 feet in height, to the working face, where the men were getting the clay. It is obtained by blasting; and the proprietors did not omit the dramatic effect, at the closing scene of the inspection, of firing one or two shots, which had the startling result, apart from the detonation, of blowing out about half of the lamps carried by the party. On returning to the surface, the visitors were entertained by the Company at dinner.

The Rev. Dr. RUSSELL, of Edinburgh, the Chairman of the Company, presided, and extended a cordial welcome to the Association. He said he was glad to know that the members desired to improve themselves and each other. They had many means by which they could do this; and there was much reason for their doing so, because he thought there was something still to be found out with reference to gas—the best mode of making it, the best kinds of materials to use, and the best way of illuminating houses, and especially large cities. He was quite surprised to learn from their President that in Glasgow alone there were 14,000 persons connected with the lighting of that great city. This showed them the immense importance of the work with which they were connected; and the more intelligently they went about their work (he was speaking particularly to the younger members), and the more they informed themselves with reference to the best way of doing it—he might say, the best way of gaining a name for themselves, and some day getting to the top of the tree, not only in being engaged in gas manufacture, but in being gas managers themselves—the better it would be for them.

The PRESIDENT (Mr. J. M'Leod, of Provan) proposed a very hearty vote of thanks to Dr. Russell for presiding.

Mr. E. M. STEWART, the Manager of the Bonnyside Works, read a paper, of which the following is an abstract, on

FIRE-BRICKS AND RETORTS.

The author said the subject was one of such wide scope and variety of detail that it was most difficult to condense even the details of a few aspects within the compass of the time allotted to him. He had, therefore, endeavoured to treat the whole subject from the standpoint of the gas manager, who entered the market to purchase refractory goods, and who desired some knowledge as to the conditions under which his goods were manufactured. The desirability of an intimate knowledge of the properties and characteristics of different classes of bricks was being recognized more and more in the gas profession, as no matter how complete a gas-works might otherwise be, unless the retorts and retort-settings were of the best description, both as to design, construction, and quality of materials, the result would be disappointing. A great improvement, however, had taken place in this respect within recent years; the gas manager now depending more on his own personal observation than formerly. That the industry was one worthy of consideration by all classes was apparent from the fact that in the year 1900 the output of fire-clay in Scotland amounted to upwards of 700,000 tons; in 1904 it had increased to nearly 1,000,000 tons; and, he believed, during the past year, it had exceeded that quantity.

Geologically, the deposits of fire-clay belonged to the carboniferous, cretaceous, and tertiary series; the two former being found almost wholly in Great Britain, and the first series comprising all the strong refractory clays found both in Scotland and England. In the latter country, those deposits were chiefly worked in the districts around Stourbridge, Leeds, Newcastle, Durham, the Forest of Dean, Buckley, Shropshire, North and South Wales, and also to a small extent in the north and midland districts of Ireland. In Scotland they were found practically in the whole of the district containing the coal measures; the most refractory being those which were in the millstone grit, and lying in the district between Garnkirk and Bonnybridge. The thickness of fire-clay seams varied considerably in a manner similar

to those of coal. They did not, however, lie in beds of such uniform thickness as seams of coal, that being specially the case with ganister, the seams of which usually presented a wavelike appearance. In their own pit at Bonnyside, the working face averaged from 18 to 20 feet in height, having various seams of clay, ganister, and coal. The average selling price of raw fire-clay in the official returns of some years ago was only 3s. per ton at the pit, and it could be quite readily understood that only those seams which did not lie at any great depth from the surface, and were of considerable thickness, could be worked at a profit. Where, however, the clay was mined along with coal, the depth and thickness of seam were not such important factors.

Mr. Stewart proceeded to deal with the preparation and handling of the clay—describing the processes of milling, moulding, drying, and burning; then referred to a few of the more common troubles of the brick manufacturer; and concluded by examining the analysis of the clay. Having explained the first three processes, he said that after being lifted from the drying-floors, the goods were taken to the kilns, in which they were "set," or built up, ready for firing. There were many types of kilns for these purposes; those principally used in Scotland were the Newcastle and round kilns with up and down draught. Experiments had recently been made in connection with gas-fired continuous kilns, which were now showing better results. After the kilns had been filled and the doors built up, the fires were lit. During the first 48 hours of firing, the heat was being gradually raised, so as to enable all moisture to be evaporated. The kiln was then brought up to its maximum heat, and continued at this temperature for about 48 hours. The greatest care had to be exercised during the operations, as if the heat were raised too rapidly it might result in the materials being spoiled or cracked. On the other hand, if the maximum temperature, after being reached, was not sustained for a sufficient period, it would result in what was locally known as a "white kiln"—*i.e.*, underfired bricks.

Passing to the portion of his subject which was of special interest to the visitors, Mr. Stewart said that if the clay was to be used for making retorts instead of bricks, the greatest care should be given to selecting and picking it; and nothing but the purest material should be used. Owing to the heating and cooling to which retorts were subjected, the danger of cracking and splitting was greater than that of bricks; and it had been found that clay for this purpose was improved by the admixture of a very large percentage of "grog." As had been shown that day, instead of being moulded in one piece or at one operation, retorts were built in vertical sections in consecutive rings, about 15 inches deep; the builder using an inside drum of the shape and dimensions required, and building the clay round it—the outside diameter being regulated by a collar or profile. A new ring could be added every two or three days, and an ordinary 9-feet retort could be built and sufficiently dried for burning in from four to five weeks from the time when it was first laid down. The increased thickness of the neck was obtained by using a larger outside profile, and the bolt-holes were cut to template after the retort was somewhat dry. In order to give the outside the requisite smoothness, it was polished by the builder a few days after each ring was built and slurried over with a mixture of wet ground clay, so as to give a uniform colour throughout. Owing to the height and weight of the retorts, great difficulty was experienced in handling them, or burning them economically, unless this was done in specially constructed kilns with removable roofs. In some districts, machines had been introduced for the moulding of retorts in one piece, on a somewhat similar principle to ordinary pipe-machines. In Scotland, however, hand-made retorts were still most in favour.

Proceeding to examine some of the more common troubles which a brick manufacturer had to encounter in the making of fire-clay goods, Mr. Stewart said the principal one was shrinkage. This contraction was two distinct operations. Roughly speaking, the first took place while the bricks were lying on the drying-floor; and the second while they were being burnt in the kilns. For ordinary fire-clays containing about 2 : 1 of silica and alumina, the contraction was one-twelfth. Therefore, an ordinary 9-inch fire-brick required to be made in a mould 9¾ inches long, and accordingly thicker and broader than the requisite fired dimensions. The shrinkage was largely dependent on the proportionate percentage of silica and alumina. If the silica content were increased, the contraction decreased until the composition of the brick reached an analysis of over 90 per cent., when expansion (instead of contraction) took place during burning. It was, therefore, important—where flat arches of large diameter had to be built with bricks of ordinary fire-clay quality, showing an analysis of about 2 : 1 of silica and alumina—that these bricks should be burned at an extremely high temperature, as, should the arch in working practice be subjected to a higher temperature than that at which the bricks had been burned, further contraction would take place, resulting in sagging, or perhaps the total collapse of the arch. When ordering bricks for such purposes, the greatest care should therefore be taken with the dimensions, so that they might fit skin to skin. In this connection, many furnace builders, instead of using ordinary fire-clay materials, now employed a special brick made of silica clay, which showed no contraction, and also used silicious clay instead of ordinary fire-clay for jointing. It was, however, to the manufacturer that shrinkage caused the most trouble—that being so great in some cases as to make it impossible to use some clay alone, owing to the large amount of breakage which occurred during drying and burning. In addition to this, some clays were also very liable to warp, and others to swell, during the process of manufacture. In all these cases, however, it had been found to be of considerable advantage to mix a percentage of "grog," or ground bricks, along with the fresh-ground clay. This material, having no fire-shrinkage in itself, tended to decrease the shrinkage of the mixture during drying and burning.

Mr. Stewart concluded with a few observations on the subject of analysis. He said the best fire-clay contained approximately about 55 to 65 per cent. of silica; 30 to 40 per cent. of alumina; 2 to 3 per cent. of oxide of iron; and 1 to 2 per cent. of alkalies. The principal elements, therefore, were silica and alumina. Both these minerals were only fusible at very high temperatures. The brick which had been found most suitable for ordinary furnace work contained the above-named proportions of silica and alumina. It had been found that if the percentage of silica were increased, it had a tendency to lower the fusible point of the brick, until it reached a total content of about 90 per cent.; while above that, the increasing amount of silica gradually raised the temperature of fusion, until it reached the melting-point of pure quartz—*i.e.*, 3325° Fahr. On the other hand, if the content of alumina were increased, it rendered the brick more liable to warp and twist during burning. The principal factor, however, in the refractoriness or otherwise of a fire-clay was the proportion of fusible impurities which it contained. These were, particularly, iron, potash, soda, titanium, lime, and magnesia. In ordinary fire-clays of the first class, the proportion of iron should not be more than 2 to 3 per cent. Any quantity above this would immediately lower the point of fusion, and relegate the brick to the second class. If the iron present existed in the form of iron pyrites in small nodules, this fusible factor could be largely eliminated by careful handling. In practice, chemical analysis was not always the true index as to the refractoriness of ordinary fire-clay, the physical condition being in some cases almost of more importance as a controlling factor than the chemical contents. It had been long recognized in practice that the size and shape of individual clay particles—in other words, the grain of the clay—had much to do with the heat resistance; that was to say, clays containing coarse angular grains stood higher temperatures, other things being equal, than the dense and fine-grained varieties. This point, as well as the presence of a large percentage of alkalis, might explain the reason why certain clays, usually wrought in conjunction with coal, and close in grain, though low in iron content, were not suitable for furnaces where the highest temperatures had to be resisted.

Mr. J. Lowe (Glasgow) said as gas engineers they were very much interested in the maintenance of retort-benches and fire-brick work. They knew that fire-bricks subjected to such temperatures as those to which they had to be exposed in gas-works had not always a very long life. They sometimes cracked and fused, and deteriorated in other ways, and had to be renewed in the course of a few years. The design of the retort-bench, he might put it, was the first function of the gas engineer; but second, and not in any way inferior, to it came the question of maintenance. It was of the utmost importance to them to get fire-clay goods of such a character that they would be durable. The ideal fire-brick, of course, had not yet been produced; and he felt sure that there was a great field for the supply of bricks of even better quality than those at present on the market. It had been very instructive to have had the privilege of going through the works, both down the mine and in the workshops, and seeing how the bricks and the retorts were made, and how they were fired; and what they had seen might help them when they had to design bricks for purposes for which they required them.

Mr. S. B. Langlands (Glasgow) desired to thank Mr. Stewart for the very instructive entertainment the members had had, and said he hoped he would convey to his Directors their indebtedness to them for their visit.

The President expressed the indebtedness of the Association to Mr. Stewart for the very educative visit they had had. The explanations of the process of fire-brick making had been very clear. When they considered the number of operations, and remembered that the prices obtained for the finished bricks were only from 11s. to 15s. per ton, it was difficult to understand how there could be a profit on the work. He noticed that Mr. Stewart employed Seger cones for ascertaining the heat. He should like to ask him if he had ever used a pyrometer; and if so, if it was a success. The suggestion had been made that they might discuss the paper some other time. If the Committee could arrange for it, he was sure they would be very pleased to have some further remarks upon it.

Mr. Stewart thanked the members for their kindly references to his paper. Pyrometers were not generally in use for testing the heat in kilns in ordinary fire-brick works, because they were expensive. But recently there had been patented a new pyrometer, called the "Féry Radiator," which promised to be less costly than any in the market. They found, however, that the use of test pieces was a sure way of working. Not only could they test the heat of the kiln at a certain period, but ascertain whether a brick was burnt through and through—whether oxidation had taken place right through the brick. He hoped the visit had been instructive; and if, as the President suggested, the paper should be taken up for discussion at a future meeting, he should be very pleased to attend and give all the assistance he could.

This brought the proceedings to a close.

MANCHESTER JUNIOR GAS ASSOCIATION.

On Saturday the Association held their Seventh Annual Dinner, at the Exchange Hotel, Manchester.

After the Loyal toast had been duly honoured, Mr. C. Berry proposed "The President;" and Mr. R. H. Ginman thanked the members and friends for the support they were giving him during his year of office. Mr. T. Thorp proposed "Kindred Associations," remarking that every junior with a spark of ambition was looking forward to the day when he would be able to join the Institution of Gas Engineers; and in including the Institution in the toast, he ventured to think the time would come when the highest official position would be held by some who to-day were members of the Junior Associations.

Mr. J. H. Brearley, the President of the Manchester District Institution of Gas Engineers, in reply, said he liked the term "Kindred Associations," for they were all alike bound together for a common object. It was difficult to define what was a senior and what was a junior member of the gas industry. The old saying "What Lancashire thinks to-day, England thinks to-morrow," was not only true politically, but had been so in connection with the Junior Gas Association movement; and he would urge them to cultivate individuality of thought, so as to strike out on fresh lines and keep ever in the forefront. Mr. C. Roper, Secretary of the Yorkshire Junior Association, also replied on behalf of the Junior Associations. The guests of the evening were Mr. Brearley, Mr. Isaac Carr, Dr. Grossmann, and Mr. Roper; and to these gentlemen Mr. D. V. Hollingworth proposed the toast of "Our Guests," to which Dr. Grossmann replied. Mr. Carr proposed "The Manchester and District Junior Gas Association," and said he had watched the proceedings of the Association with interest and profit from its very infancy. In years gone by, a man was marked by the stamp of the works at which he had been trained; and he bore the impress of the engineers under whom he had served. Now, thanks to the Junior Associations, the young men were looking over other works and getting a broadened outlook. His own success he attributed to attention to small details; and he ventured to urge its importance upon juniors present.

DOMESTIC AND INDUSTRIAL USES OF GAS.

Last Tuesday evening, a paper on the above subject was read by Mr. F. W. Goodenough to the members of the Bartholomew Club, in their club room at Snow Hill, E.C.

Mr. Goodenough said that one of the oldest jokes in existence was about the lying gas-meter; but anyone who had an idea that it was an unreliable instrument, was much mistaken. For an instrument set in position and left without attention for years, it was a remarkably accurate recording machine. If it erred, it was more likely to register against the company than against the consumer. Over a period of five years, 50 per cent. of the doubted meters (not the meters actually in use) had proved on test to be accurate, or practically so. Of these, 25 per cent. had been shown to be too slow, and 25 per cent. too fast. On the face of it, this seemed an even balance; but, as a matter of fact, when a meter registered against the company the probabilities were that the error was much greater than when it registered against the consumer. He advised his hearers to learn to read the index, and to check the gas consumption each week, the same as they did with their food or coal. He afterwards proceeded to detail the developments in the gas industry by the invention of the bunsen burner, which rendered it possible to use gas for heating purposes, and led up to incandescent lighting.

After speaking of the advantages of incandescent lighting as compared with the flat-flame system, Mr. Goodenough recommended the members to entrust the maintenance of their incandescent burners to the gas company, and said it was quite a mistake to rely upon casual attendance, or wait until something had gone wrong. Houses lighted by gas, he said, had generally a much more cheerful appearance than had those lighted by more expensive illuminants. In heating and cooking, gas had brought about almost a revolution, and robbed the domestic-servant problem of many of its terrors. His Company had half-a-dozen ladies who were experts in the use of gas for cooking, and who were sent, free of charge, to any consumer who desired their services. It sometimes happened that the husband sent an application, and when the expert arrived she found that the wife and servant supposed that they knew as much as she did. It required in these instances tact and judgment to get into the house at all or into the kitchen; but the result invariably was that the wife and the servant, even though they might have been using gas for cooking for years, found they had a good deal to learn, and profited by the visit.

After referring at some length to the advantages which gas possessed over coal for cooking, Mr. Goodenough spoke of its use in laundry work, and for obtaining hot water either constantly by circulation or quickly on sudden emergencies. There was, he said, an impression abroad that gas-fires were not so healthy as coal; but many of the most eminent men in the medical profession now, immediately they saw that a person was in for a long illness, ordered a gas-fire to be put in the room. The reason for this was that an even temperature could be maintained, that there was no fear of the fire going out through inattention, and that the noise of cinders falling and of putting on coal was obviated. After quoting the conclusions arrived by the "Lancet" Commission, that gas-fires were not prejudicial to health, the speaker asked how they could be, seeing that the heat from the gas-fire was exactly the same as from a coal-fire, except that the latter was burning crude instead of purified gas. His Company had more gas-fires proportionately, in doctors' houses in Harley Street and neighbourhood, as well as in other districts, than in the houses of any other class of the community. Some people put in gas-fires because their chimneys smoked, without seeing that steps were taken to counteract the down-draught; and the results in these cases were not satisfactory. But where there was no down-draught, or where means were adopted for dealing with it, and the room was properly ventilated, there could be no possible objection from a health point of view to gas-fires in rooms. The introduction of gas-fires in a large house would enable the owner to dispense with one servant. He was not going to say that, hour for hour, a gas-fire was as cheap as a coal-fire. It was not as cheap as a coal-fire in a room where constant heating was required, unless the saving in labour and in dirt were taken into account. The direct and certain saving was in its use in a room only occasionally required, and also in the quickness with which it could be lighted, and put out; and there was the indirect saving in labour and preventing damage from smoke and soot.

Turning to the use of gas for industrial purposes, Mr. Goodenough said the originators of the gas industry would be astonished to find the wonderfully broad basis upon which it now stood. In practically all the large hotels and restaurants, it was used for cooking purposes; it was used in newspaper offices in connection with linotype machines and gas-engines; it was employed for cloth pressing, tobacco drying, all kinds of metal working, the manufacture of golf balls, and endless other purposes. Some £500 a year was paid by one firm for gas which was exclusively employed in the bending of walking sticks. Large quantities were even consumed in the making of electric light cable, which was strong evidence that electricity was not economical as a heating agent. It was surprising how many industries would be brought to a standstill, or seriously inconvenienced, if the supply of gas was stopped.

A discussion followed, in which the majority of the speakers gave testimony to the value of gas for several purposes.

Replying to some questions and criticisms, Mr. Goodenough gave several reasons why the price of gas was higher on the north side than on the south side of the Thames. Referring to some remarks as to the supposed dangers from gas, Mr. Goodenough said that the real risks from gas were extremely small, while those from electric light were often not realized as they should be. A number of fires were known to be caused by defective electric insulation, and there were a number of unknown fires which probably arose in the same way. Fires from electric wires destroyed the evidence of their origin. The speaker proceeded to call attention to a report from the London County Council, which pointed out that fatal and other accidents in poor neighbourhoods had enormously decreased since slot-meters enabled the inhabitants to substitute gas for paraffin oil.

A hearty vote of thanks to Mr. Goodenough for his paper brought the proceedings to a close.

Power-Producing Efficiency of American Coals.

In the Engineering Supplement to "The Times," Mr. J. Shober Burrows has lately been dealing with the subject of coal-testing, in connection with the work of the Fuel-Testing Committee of the United States Geological Survey. It appears that some scepticism was expressed as to the claims made by the Committee in regard to the power-producing efficiency of coals used in the gas-producer and gas-engine; and therefore an "endurance test" was undertaken, extending over 24 days. The average of six analyses of the coal used showed 14·68 per cent. of moisture, 30·98 per cent. of volatile combustible, 42·93 per cent. of fixed carbon, and 11·41 per cent. of ash, including 1·33 per cent. of sulphur. The heat value of dry coal was 12,343 B.Th.U. per pound. The coal was broken to about 3-inch size, and delivered to the charging-floor of the producer by a belt conveyor; and it was charged into the producer at intervals varying from 25 to 30 minutes. The weight of each charge was 150 lbs. The gas left the generator at an average temperature of 644° Fahr., and passed through a water-seal dust collector, and thence to the scrubber. From there it went directly to a centrifugal tar-extractor, which removed the greater portion of the tar. It was then delivered direct to the holder—no further attempt being made to purify it. During the entire test, calorimetric determinations of the heat value of the gas were made every 20 minutes, and volumetric analyses every two hours. The average heat value of the gas for the entire run was 156·1 B.Th.U. per cubic foot. Observations relating to the tar extracted during the test are of special significance, as it has often been stated that no plant which separates the tar mechanically could run for more than five or six days without shutting down. The total tar extracted during the test amounted to 14,950 lbs., or about 143 lbs. for every ton of coal burnt in the producer. The tar did not contain more than 10 per cent. of water. The engine ran in perfect order at all times during the period of the experiment, and at the end was found in unimpeachable condition. The producer plant was also in excellent order.

REGISTER OF PATENTS.

Incandescent Gas Lamps, Burners, and Fittings.

HELPS, G., of Nuneaton.

No. 328; Jan. 5, 1906.

This invention consists in a burner in which the air inlets are so protected that they may be located outside the lamp globe or casing with a flexible connection by which the burner can be readily disconnected and removed for cleaning and other purposes.

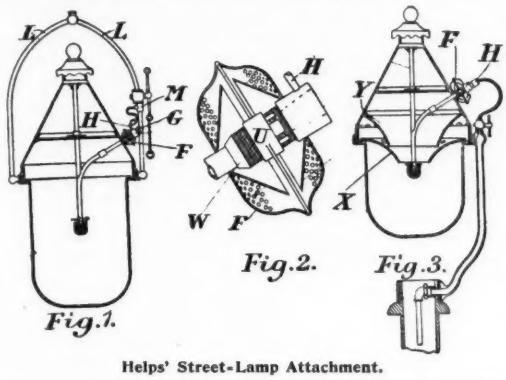


Fig.1. Fig.2. Fig.3.

Helps' Street-Lamp Attachment.

Fig. 1 shows one form the invention may take when applied to an ordinary well lamp. The burner-tube is rigidly secured to the top of the lamp by a support and bridge piece. It is in two parts, secured together by a socket or other attachment. F is the protector surrounding the air cone, an enlarged view of which is shown in fig. 2. G is the movable nipple plug fitting into a socket, and H the gas connection terminating in the plug and socket joint to which a flexible tube is attached. The gas passes down the supporting arm L; the flexible tube being attached to the branch at M.

Fig. 2 shows an air-cone protector, with suitable baffles and air inlet perforations. The protector is secured to the air adjusting ring U by arms, so that it can turn freely on the screwed air cone W.

Fig. 3 shows the invention applied to a well lamp on an ordinary column. Here the air for combustion is prevented from mixing with the products of combustion by the introduction of a deflector Y. The air passes to the mantle through holes in the reflector X. In this case there is only one plug joint; the nipples being on the plug to which the flexible tube is attached.

Obtaining Ammonia from Gas Liquor.

FILLUNGER, A., of Mährisch, Austria.

No. 11,077; May 11, 1906.

This invention (the specification of which is not illustrated) consists in the waste water coming from the apparatus being led back into the gas washer, scrubber, or the like, after having been cooled, in order, when charged with fresh ammonia, to be led again into the apparatus and, after giving off the ammonia newly taken up, to be led back into the scrubber, and so on in a perpetual cycle.

The observation has been made, says the patentee, that in this cycle the proportion of fixed or non-volatile ammonia salts in the waste water does not increase; so that an addition of lime which is required for the precipitation of the fixed ammonia salts is not necessary. This observation leads to the obvious supposition that the retort gases contain no fixed ammonia salts; that these rather are only formed by the process of chemical transposition during the washing of the gases with ordinary water under the influence of the salts dissolved in the water. Accordingly, if no fresh water is brought into use in washing, there can be no increase of fixed ammonia salts. Indeed, experiments have been made, in which retort gases were washed with distilled water, with the result that absolutely no fixed ammonia salts were present.

If in this improved method, as is usual in other methods, steam at a temperature corresponding to the pressure were employed for driving off the ammonia from the gas liquor, the quantity of waste water would be increased by the vapours contained in the steam and condensing out of it. The constantly increasing quantity of water would make it necessary to allow part of the waste water containing exclusively fixed ammonia to run away, which would naturally involve a loss of ammonia, or, in order to avoid this, a part of the gas liquor would have to be distilled with lime, which, however, would be likewise disadvantageous.

Now the present invention relates also to a method for preventing the washing water from increasing in amount on account of the free water contained in ordinary steam, and for preventing the ammonia water from becoming diluted, which would otherwise be the case on account of condensation. This object can be obtained in a two-fold manner according to whether ordinary or superheated (that is dried) steam is employed. In the latter case—that is, when superheated or dried steam is employed—the washing water is prevented from increasing by there being no free water contained in the steam, and by a greater calorific effect being attained by means of the higher temperature, whereby it is possible to consume less steam, so that less condensed water is formed. In the present case, the distillation of the ammonia water may take place in the ordinary column apparatus heated directly.

If the conditions of the case require steam to be employed at a temperature corresponding to its pressure, the object of the invention can be obtained by treating the ammonia water in column apparatus heated indirectly; the employment of superheated or dried steam being possible, of course, but more expensive.

The method according to the present invention may be carried out in the following manner: The gas liquor is distilled in apparatus of known kind—for example, in a column apparatus, without an addition of lime; the free ammonia being driven off, while only small quantities (about 0·05 per cent.) of the fixed ammonia present in the form of salts are contained in the waste-water running out of the apparatus. Now this waste water is preferably pumped on to a tower or like apparatus and cooled to the temperature of the air, or some degrees lower, in order then to be employed in trickling through the scrubber without anything further being done to it. Losses of the ammonia contained in the waste water are excluded, as the ammonia is exclusively present in non-volatile form.

The gas liquor running away from the scrubbers which is now again enriched, is led again to the distilling apparatus in order to be here freed from the ammonia taken up in the scrubbers; the water being then again used in trickling through the scrubber for the purpose of enriching itself, and so on. Thus one and the same quantity of gas liquor continuously circulates; and the addition of new water for washing is superfluous.

This circumstance, it is said, makes the present method particularly suitable for plants in which there is a scarcity of water. Further, since the total quantity of waste water leaving the distilling apparatus at any time circulates in the working of the plant, the quantity of ammonia which was hitherto in the waste water which ran away is retained, or the loss of ammonia which took place in the methods formerly in use is avoided.

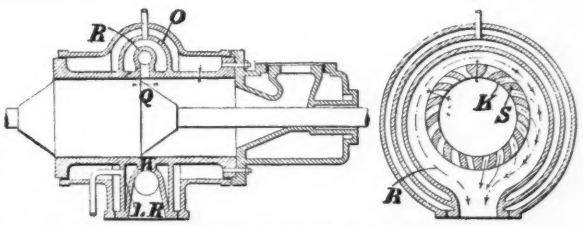
A further advantage consists in avoiding milk of lime, the employment of which (apart from the heavy cost connected with its supply) causes a number of disadvantages, inasmuch as the milk of lime pumped into the distilling apparatus causes the formation of hard deposits in the apparatus, makes necessary a thorough cleaning of the plant after a comparatively short time of work, involving a discontinuance of operations for a time, and, moreover, necessitates an increased use of steam while working. Further, since the so-called waste water running out of the apparatus during the distillation with lime must be led into reservoirs for the purpose of depositing the mud before it can leave the works, these settling reservoirs must naturally be drawn off from time to time and the mud which has collected must be taken away, which again leads to a considerable increase in the cost of working.

Gas-Engines with Two-Stroke Cycles.

SCHWEHM, P., of Hanover.

No. 873A; Jan. 12, 1906.

In this arrangement of gas-engine, the patentee proposes to increase the sectional area of the partitions which separate the consecutive exhaust slots from each other, whereby the cylinder walls are, without danger of cracking, enabled to transmit the tensile strains caused by the explosion.



Schwehm's Two-Stroke Cycle Gas-Engine.

The exhaust pipe or passage R surrounding the cylinder is circular in cross section. It is placed at a short distance from the cylinder, and is connected with the latter not by plain slots in the cylinder wall, but by special ports K provided with special cooling walls. In this way, it is possible to increase the height (or radial length) of the ports and of their partitions or guides S to any desired extent, without increasing the uncooled mass of the partitions. On the contrary, the walls of the ports, being themselves kept cool by the water surrounding the exhaust pipe, serve to cool the partitions. The width of the uncooled zone Q of the cylinder is thus rendered independent of the sectional area of the exhaust pipe R, and depends only on the (axial) width of the exhaust ports.

To increase the cooling effect, a canal may be formed around the wall and fed at its deepest point L with fresh water through a separate feed-pipe. The cooling water may pass from the canal at its highest point into the cooling jacket of the power cylinder through openings O. The latter may serve for admitting cooling water from the cooling jacket of the cylinder to the canal, in case it has been inadvertently omitted to open the feed-pipe at the time of starting the engine.

Incandescent Gas-Burner.

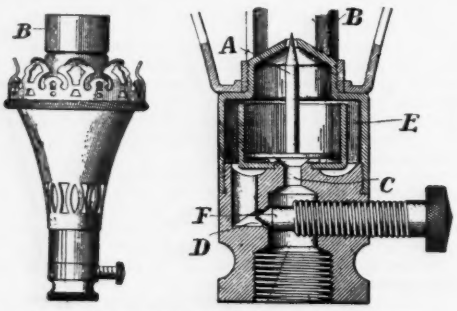
BOULT, A. J.; a communication from the NATIONAL GASLIGHT COMPANY, of Michigan, U.S.A.

No. 18,043; Aug. 11, 1906.

The patentees' object is to control the feed of gas through a bunsen regardless of any variation in pressure.

As shown next page, the burner comprises a nipple surmounted by a removable hollow cap, and with a cylinder carried by the upper end of the nipple and confined within the cap. There is also a self-adjusting needle-valve carried by a disc A movable within the cylinder, and a bunsen burner or mixer tube B having air inlets above the cap. The nipple has formed in it a chamber from which a passage C extends upwardly, to admit gas beneath the disc, and a passage D communicating laterally with a vertical passage, which, in its turn,

communicates with a chamber E formed between the cylinder and the interior of the cap. The nipple preferably has at its top a boss through which the passage C extends; and the cylinder (open at its upper end) has an interned flange at its lower end which fits upon the boss and is secured on it by a burr. The needle-valve extends, when the disc is at the lower end of its traverse, into an orifice with which the cap is provided at its apex—a passage being afforded for gas, however, in this position. The lateral passage D is guarded by a valve F, which has a threaded shank extending through the opposite wall of the nipple. A knurled head enables adjustment to be made; and the reduced extremity forms the valve.



National Gaslight Company's Regulating Burner.

In the normal operation, the gas is admitted through the lateral passage D, the vertical passage connected with it, and the annular chamber E, and the pressure is also admitted to the cylinder beneath the disc. The pressure causes the needle-valve to rise and obstruct the orifice until the back-pressure due to the constricted opening, taken in connection with the weight of the valve, is sufficient to balance the lifting force upon the valve. It will be obvious therefore that the device may be adjusted to varying pressures by regulating the position of the valve F, whose stem projects laterally from the nipple so as to enable this to be accomplished.

Producing a Constant Mixture of Gas and Air.

AKTIENGESELLSCHAFT FÜR SELAS-BELEUCHTUNG, of Berlin.

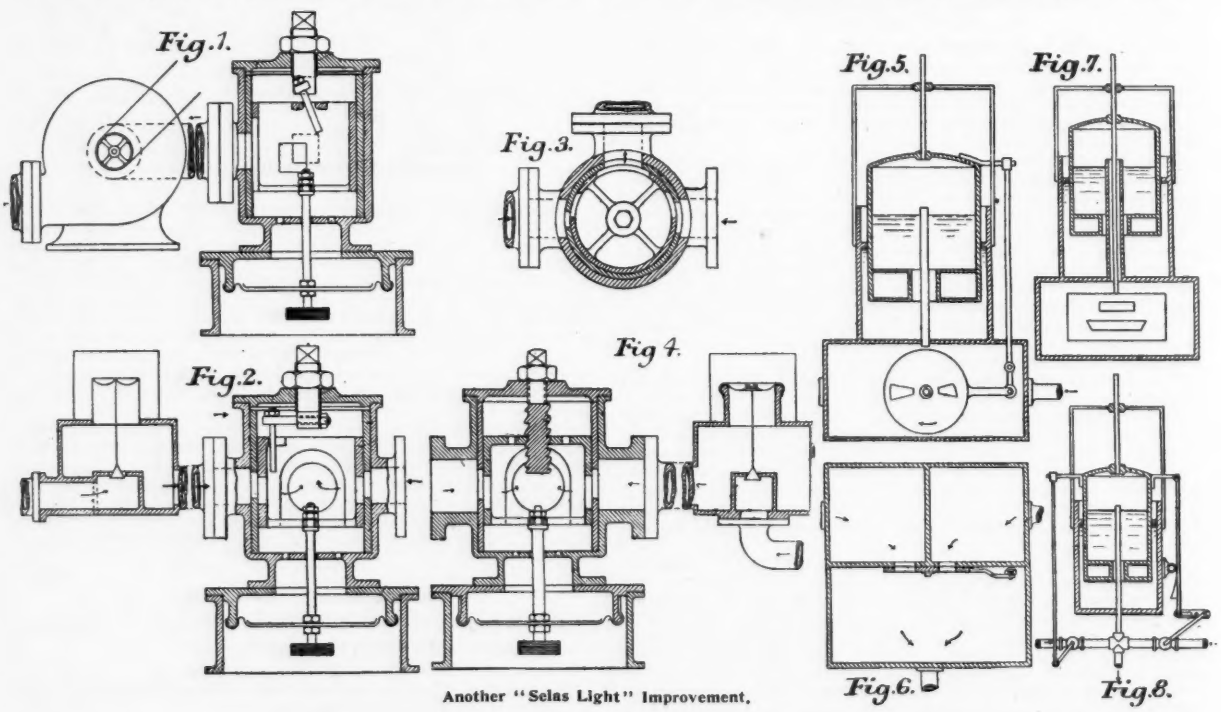
No. 21,847; Oct. 3, 1906. Date claimed under International Convention, Oct. 7, 1905.

This invention relates to a process for the production of a constant mixture of gas and air for illuminating purposes, with the employment of suction and forcing apparatus, the action of which is regulated in dependance upon the consumption, and which produces and sucks the mixture at low pressure, and sends it at an increased pressure into the service pipe.

As shown, the cross sections of the gas and air inlets are modified in two senses for the purpose of equalizing, on the one hand, the difference of pressure between the suction pipe for the mixture and the supply pipe for the gas, and, on the other hand, the difference of pressure between the suction pipe for the mixture and the air supply pipe. In addition to this, the regulating device is actuated dependantly upon the quantity of gas and air mixture withdrawn from the service pipe, but indirectly under the influence of the suction effect of the suction and forcing apparatus. In addition to presenting the possibility of regulating the operation in a simple manner, the process ensures that, even when the quantities of gas and air mixture withdrawn vary largely, a constant mixing ratio between the gas and air will always be obtained.

In order to obtain these objects, the inlets for the gas and air are enlarged and reduced under the influence of a governor in correspondence with the increase and decrease of the quantities supplied. By this means the pressure in the suction chamber is maintained at a given height, and irregular action of the suction pressure upon the admission apertures is avoided. At the best, however, it is only possible in this manner to maintain the suction pressure at a given height in the suction chamber with fluctuations within certain limits. These special fluctuations of pressure, the patentees remark, have their origin in the sources of error in the governor—for example, in the case of float-bells in the variations of the depth of immersion; with membrane governors, in the differences of tension which arise in the membrane; and so forth. It has also proved that even when the pressure in the suction chamber is maintained entirely constant, variations in the composition of the mixture of gas and air arise with varying withdrawals, even if the cross-section of the inlets is regulated dependantly upon the consumption in the manner described. The reason for this appears, they say, to be that the co-efficient of resistance for gases of different specific weights—such as illuminating gas and air are—does not alter proportionately with the enlargement or restriction of the apertures of different magnitude. Accordingly, the smaller the admission cross-sections are, the more speedily and higher does the resistance curve exceed the proportional amount. These causes, and others of undesirable variations of the mixture arising from sources of error in the apparatus, must be compensated for by a second adjustment of the cross-section of the inlets. This second adjustment of the cross-section takes place in positive dependance upon the first proportional adjustment of the admission cross-sections, owing to the fact that some or all of the cross-sections experience an additional adjustment, so that for every separate setting effected by the first proportional adjustment the errors are compensated for.

The process to be employed in accordance with the invention may be carried into practice in various ways. An obturating member common to the gas and air inlets, and effecting a simple movement, may be provided. In this case, the second adjustment is obtained by the special formation and position of the obturating edges and of the admission apertures. The second adjustment of the inlets may, however, also be obtained owing to the fact that the obturating member common to both inlets, in addition to receiving the movement dependant upon the consumption, also receives a further special movement, so that the double regulation is caused by the modification of the position of the inlets. This arrangement presents the advantage that the second adjustment may be variable, or capable of regulation. Further, the inlets for air and gas may be provided with separate obturators, which are influenced by the governor in dependance upon the consumption or the operation of the suction and forcing apparatus. The obturating member (or two obturating members) may be provided with special means for effecting the second special adjustment. For the rest, obviously the manner of the double regulation depends upon the number of inlets for gas and air.



Another "Selas Light" Improvement.

Several examples for carrying the process into practice are illustrated. Figs. 1 to 3 show an apparatus with a rotary forwarding device, and adjustable cylindrical obturating member. Figs. 1 and 2 show the governor in two vertical sections in two planes perpendicular to each other. Fig. 3 is a horizontal cross section. Fig. 4 represents another constructional form with adjustable obturating member. Figs. 5 and 6 illustrate in side elevation and horizontal section an apparatus the obturating member of which has curved closing edges. Fig. 7 shows a similar constructional form with inclined closing edges on the

obturating member. Fig. 8 shows an apparatus with separate obturating members for gas and air.

The process may be carried into practice in numerous ways. Not only bellows or bell governors, but other devices likewise are adapted for regulating the admission cross-sections; and the displacement of the obturating member may take place in any appropriate manner—say, axially, obliquely, or helically. In place of a cylindrical obturating member, as shown in figs. 1 and 4, a semi-cylindrical, or approximately semi-cylindrical, obturating body might be employed. The means for effecting the separate adjustment may be modified as desired. For example, in the construction represented in figs. 5 and 7, the openings of the gas and air supply pipes might carry the means for producing the second adjustment instead of the inlets of the obturating member. The admission edges may be of any appropriate kind, either inclined or curved (as shown) or stepped. The regulation of the forwarding apparatus may also be effected by driving it quicker or slower in dependance upon the consumption. Again, the alteration of the cross-section of the gas and air inlets might be produced by a liquid seal with varying position of the level—for example, by employing two liquid reservoirs communicating by a conduit; the contents of one of them being partially transferred to the other by the action of the suction process. It is said to be essential that in all cases the cross-section of the gas and air inlets should be altered in a double sense, for the purpose of maintaining constant the difference of pressure between the suction conduit on the one hand, and the supply conduit for gas and air on the other hand, whereby the means for automatically varying the cross-sections of the admission apertures (the so-called admission governor) may be displaced by means of the pressure or by the suction conduit, or in any other workable manner.

Incandescent Gas-Burners.

TWIGG, W. W., and WATSON, J. H., of Birmingham.

No. 1790; Jan. 24, 1906.

This invention is particularly applicable to inverted burners; its object being the "better mixing of the gas and air, thereby ensuring more perfect combustion." The patentees propose to insert in the tube of the burner one or more strips of metal (preferably formed into a spiral or twisted shape) in such a manner that the current of gas and air in its passage through the tube is divided into two or more parts, which, passing along the sides of the strips, is given a twirling or rotary movement—the currents again joining and mixing together at the lower end of the strips.

Gas-Mantles.

VAN VRIESLAND, A. I., of Scheveningen, Holland.

No. 18,152; Aug. 13, 1906.

This gas-mantle consists of flat woven, knitted, or plaited material made into the usual shape by drawing it over a suitable form. In this way it is said advantages are obtained in many respects, especially when used in connection with inverted burners. Those hitherto used, consisting of "pieces of hosiery," were made into the desired form by sewing together one of the openings in the hosiery. But in this way an aggregation of material arises in one part and a formation of folds, whereby the illuminating power of the mantle is diminished. The "new mantle," on the other hand, has its closed part quite smooth and uniform, and "consequently the rays of light are in no way prevented from radiating downwards." The mantle thus produced is subjected to the action of chemicals, having a contracting or shrinking action—such as lyes, acids, or salt solutions—whereby any existing folds are got rid of.

The patentee says he is aware that, according to patent No. 24,680 of 1905, a tubular material was treated in substantially the manner described, and he makes no claim thereto as part of the present invention, neither does he claim *per se* the use of flat material for the formation of mantles. What he claims is: "Incandescent gas-mantle, the distinguishing feature of which is that it consists of flat woven, knitted, or plaited material, converted into the form of a mantle by being drawn on to a suitable form, and subjected to the action of chemicals having a contracting or shrinking action—such as lyes, acids, or salt solutions—in order to remove any existing folds."

APPLICATIONS FOR LETTERS PATENT.

908.—ACKLAND, T., "Stopcocks." Jan. 14.
909.—HELPS, G., "Bunsen burners." Jan. 14.
949.—RADFORD, R. H., "Gas-heated furnaces." Jan. 14.
1033.—RICHARDSON, G., "Gas firelighter." Jan. 15.
1040.—REGAN, J., "Gas-burners." Jan. 15.
1056.—WISS, E., "Welding burners." Jan. 15.
1201.—MARKS, E. C. R., "Igniting gas-lamps by means of electric sparks." A communication from Aktiengesellschaft für Automatische Zund und Lösche Apparate." Jan. 16.
1235.—TWEEDIE, R. O., "Gas-burners." Jan. 17.
1263.—JOUVE, A., and GAUTIER, G., "Purification of gases." Jan. 17.
1294.—AHRBECKER, H. C., "Fluid meter." Jan. 17.
1308.—WEBSTER, M., "Enabling street and similar lamps to be lighted and extinguished." Jan. 18.
1313.—DANIELS, J. S., HIGGINS, E. P., and DANIELS, F. L., "Gas producers." Jan. 18.
1349.—TERRELL, T., "Incandescent burners." Jan. 18.
1389.—MILBOURNE, R. J., "Discharging purifiers." Jan. 18.
1393.—CARY, H. B., "Mixing a combustible with air." Jan. 18.
1394.—CLEVERLY, E. G., and ANDERSON, F. L., "Controlling the passage of liquids or fluids." Jan. 18.
1411.—MARSDEN, H., "Exhausting gases from retorts." Jan. 19.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by our Correspondents.*]

Westminster Electrical Laboratory Photometrical Tests.

SIR,—When I sent you my lamp test report for review, I anticipated receiving some adverse criticism. As, however, I am anxious to learn the views of gas people on the question of how gas-burners should be tested, I am willing to put up with a certain amount of adverse criticism. Your reviewer, however, has, I consider, treated me most unfairly, and appears to me to have gone out of his way to find fault with my methods where they are in reality much fairer than those which he would substitute.

In carrying out these laboratory tests, I have aimed at getting as nearly as possible to the conditions obtained in practice by the average consumer—not by the expert, who adjusts his gas and air supply every five minutes, and who cleans his chimneys and burners every other day. The average consumer knows nothing of these things. It must be remembered that, whereas in electric lighting the control of the conditions is almost entirely out of the hands of the consumer, in gas lighting everything depends upon the attention given by the consumer, if he is to obtain the best results.

I have taken the average consumer as my basis; and I maintain that my figures do serve as a very useful basis from which the relative costs of gas and electric light can be calculated, when the other determining factors are known. These factors are the price of gas and current, the minimum candle power required in the various rooms, and the habits of the consumer—such as, for example, the use made of his dining and drawing rooms respectively. I have calculated out for my individual use the costs for lighting my own house, and find that, in my case, the only room in the house that it would pay me to light by gas would be the kitchen, although a householder of different habits would no doubt be wise to light his house differently.

I would suggest that laboratory tests carried out on burners adjusted to give their best results are absolutely useless, and never will I agree to conduct tests under such conditions. I test electric lamps on their marked voltage, irrespective of whether that is the best voltage for each individual lamp; and I propose to test gas-burners in a somewhat similar fashion.

I quite agree with your reviewer that burners will not give the same results on different qualities of gas. I have felt this all along; but short of making a different set of tests in every town, I do not see how it is to be got over. Possibly, however, some gas engineers may be able to correct my results to suit their own gas.

The air supply to the burners did remain constant, as your reviewer suggests. This is quite fair. Only the Block burners were fitted with air-regulators. Very few gas-burners are fitted with air-regulators, as a matter of fact; and in spite of what your reviewer may say, I do not for a moment believe that the average consumer takes any notice of air-regulators. As to adjusting them for every change of pressure and quality of gas, that is most absurd. He does not do it; and nothing will ever persuade him to do it.

It is true that the chimneys were not cleaned during the 500 hours' run. This I maintain is in accordance with practice. I do not suppose one consumer in a hundred cleans his chimneys except when he puts on a new mantle.

The nipples of the burners were cleaned at intervals during the run. This was done in order that the consumption might remain constant, and in consequence of it I was able to obtain more concordant results than if I had allowed them to take their chance. I am now, however, inclined to think that I should have done better to have left them alone, in which case the candle power of the mantles in almost every case would have fallen somewhat more. I think that this would have been fairer.

As to cleaning the gauze caps during the run, I doubt whether one consumer out of a thousand ever does this except when renewing a mantle. The tests would indeed have been useless if I had ventured to do so.

As regards the question of the standard of light adopted, I would point out that standard incandescent lamps are superior to the pentane lamp for general use, and that, as a matter of fact, the pentane lamp only gives standard candle power when used in one situation—namely, in a particular photometer room at Bushy House. Even then elaborate corrections have to be made for humidity and barometric pressure. I have for some years past abandoned the use of the pentane lamp in my own laboratory, but take the standard pentane lamp at the National Physical Laboratory as my standard of reference. I obtain very much more accurate results than I used to do in the days when I used the pentane lamp in my own laboratory. My results are quite comparable with others using the pentane lamp as their standard, if they have in their photometer room the same atmospheric conditions as at the National Physical Laboratory, and if also the room is equally lofty. From what I have heard, however, I am inclined to think that the majority of gas engineers have not these conditions, and are obliged to ignore the variations of their pentane lamps owing to the want of a really constant light against which to test them.

I would point out that your reviewer is incorrect in stating that I have given a widely different consumption for the same burners with different mantles on them. As a matter of fact, each mantle was run on an absolutely new burner. The burners were not all bought at the same time; and it is not my fault if the makers supply burners differing to a certain extent in consumption. The fact is that burners are now made so badly that no two of them taken out of the same batch have the same consumption. For this reason I am doubtful whether I should not have done better to have determined the mean consumption of a number of burners at standard pressure, and then to have tested all at this consumption, varying the pressure slightly for each burner. As a matter of fact, I did vary the pressure slightly during the tests, so as to get the same weight of gas through the nipples throughout each run, no matter what variations of temperature or barometric pressure

took place. I shall be glad to hear the views of gas engineers on this question.

I am not afraid of being called upon to substantiate my figures. The conditions of the tests are clearly stated; and under these conditions certain results were obtained, and nobody can refute the facts.

Finally, I would like to state that I have endeavoured throughout to free my mind from bias in carrying out these tests, and as the report is intended for the use of those engaged in either the electrical or gas industry, and not for the consumer direct, I can have no object in trying to make one form of lighting come out worse than the other. The people who subscribe for these tests are already committed to either gas or electric lighting, and are not consumers wavering between the adoption of gas or electric lighting. Such persons, however, are probably desirous of knowing what their rivals are able to do; and the report shows them the sort of results that are likely to be obtained in practice.

If any gas engineer can give me advice as to how I should modify my methods of testing on the next occasion, I shall be exceedingly grateful—bearing in mind that my object is to get at the efficiency of gas lighting under average working conditions.

LANCELOT W. WILD.

York Mansion, York Street, Westminster,
Jan. 25, 1907.

[There is no doubt that Mr. Lancelot Wild believes thoroughly in himself and his methods of testing incandescent gas-burners. To discuss with one who holds such dogmatic views as to what gas consumers do, or refrain from doing, is almost useless. According to our correspondent, the average gas consumer continues to neglect the practical lessons of a quarter-of-a-century's experience, and the instruction of those who supply him with gas has been all in vain. The average consumer, he holds, still treats his burner and mantle in the old barbarous fashion; and the consumer's intelligence has not taught him that he can get a superior light by the mere regulation of his gas-tap and the air-collars (which most modern burners possess), and by cleanliness. "Therefore," in effect argues Mr. Wild, "because it is my belief that the average consumer treats his burners and mantles in a barbaric manner, I shall introduce the same treatment into the science of photometry—the science of photometry as practised at the Westminster Electrical Laboratory." We have certain admissions in Mr. Wild's letter that prove that our assumptions (which, in view of the results of Mr. Wild's tests, we felt sure were well founded) were correct, and which allow us now to recommend the first volume of tests, not as tests of the capabilities of incandescent gas-burners and mantles, but as tests of what the indolent consumer obtains by neglect in the use of those burners and mantles. It is altogether a new proposition that burners and mantles should be debited with negligence, and that credit should not be given to them for all the virtue they show themselves to possess in the hands of the intelligent consumer, who, knowing the way to get the best value out of his gas, gets it. Whether the consumer is intelligent or not, each time he touches the gas-tap he changes or regulates the consumption. That Mr. Wild did not do. Now, if Mr. Wild will make a similar series of tests, using burners and mantles as a man would who wants to get the most out of them (not as the "expert" whom Mr. Wild apparently knows who adjusts his gas and air supply every five minutes, but as the consumer does who, when he lights up each day, turns his gas-tap until he gets maximum light, and as many do, if the light is not good, gives the air-shutter a turn, and occasionally, when the light begins to decline, lifts off the mantle and blows through the burner head to clear the gauze), then there may be use in the old and the new tests to show consumers, by comparison, what they lose by neglect. Mr. Wild's experience may not have taken him back to the City of London Gas Act of 1868, in which the principle was laid down that, in the testing of gas, the standard burner was to be used in the manner that would realize from the gas its greatest illuminating power. That is a just principle, which is recognized again by the air-regulating damper in the latest standard test gas-burner; and it is the just principle that we wish to see applied to the tests of all burners. We agree that the control of the electric lamp is kept entirely out of the hands of the consumer, simply because there are no practicable means by which there can be regulation on his part; and so much the worse for the consumer, as Mr. Wild's experience with varying voltages on the Westminster electricity system has no doubt led him to appreciate. But the electric lamps were all tested at their marked voltage, and that voltage was kept constant. That is not the condition that obtains in the case of the consumer. In this, Mr. Wild favoured the electric lamps; but he declined to recognize the favourable condition of control that every incandescent gas-burner (which, excepting in the case of one or two special makes, has every part separable by unscrewing) puts into the hands of consumers. Therefore the tests are not comparable as a basis for cost; and we must seriously protest against the negligent consumers' ill-use of burners and mantles being taken as the basis of any such comparison of cost with electric lamps. On all grounds, we assert the tests are unfair, and are not comparable. Mr. Wild imposes a stupendous task in asking that the habits of individual consumers should be considered in relation to costs. As an expert, Mr. Wild would exercise care with his electricity, and reject lamps when their efficiency has dropped below a certain point. Perhaps the "average" electricity consumer does not do one or the other. But are they "factors" for consideration in discussing relative costs? The question of the pentane standard lamp is referred to in our editorial columns.—ED. J.G.L.]

The Transport of Sulphate of Ammonia.

SIR,—As a subscriber to the "JOURNAL" (through my company) for a number of years, through special interest, I have each week scanned your pages in the hope of seeing an article describing the handling, &c., of a consignment of sulphate of ammonia from leaving the gas-works or coke-ovens to arrival and distribution in a foreign part—say, at Kobe, Japan.

Such an article would explain (to me at any rate) why it is necessary to bag sulphate in (say) 2 cwt. quantities; why if this is necessary for carrying by natives overland on arrival at port (as I have so far had explained to me) the sulphate is not sent (say) loosely in special compartments of the ship's hold, and packed at the foreign port into bags, where perhaps the labour cost of packing would be cheaper, and also packing material for the lesser carrying distance. Second-hand bags at present cost 5¾d. each.

Perhaps *ignoramus* will be your reply; but, at any rate, I think—apart from the business instruction—a very interesting and readable article might be written on this subject.

M.C.

[The transport of sulphate of ammonia from the manufacturers' works to the hands of consumers abroad is practically the same as that of any other manufactured article—there is nothing special about it. The reason it is not carried in bulk is that, on so valuable an article, too much waste would be involvod in transit by railway, from railway to free on board ship, and during discharge abroad—perhaps into lighters, perhaps on to open quays. It is just the same with other goods of a like character. It rarely happens that any one shipment would fill any one hold; and it is very doubtful, in any case, whether the owners of the steamers would carry sulphate of ammonia in bulk even if shippers cared about taking the risk of wastage. Sulphate of ammonia is, moreover, a solvent salt; and is therefore specially liable to damage by water. There would also be risk of damage by dirt or other discolouring matter.—ED. J.G.L.]

Dangers of the Electric Light.

SIR,—At the inquiry held by the City of Dublin Coroner in connection with the unfortunate explosion in the purifier-house at the Dublin Gas-Works, I notice that Mr. E. Jackson, H.M. Inspector of Factories, stated that, "after his experience of the accident, he should, in future, recommend electric lamps with a dry battery instead of electric lamps with wire attached, so as to do away with the possibility of fusion, which he thought was the cause of the accident." In your leading article on the subject in the "JOURNAL" for the 22nd inst., you state that: "In many gas-works in the country, electric lighting is the vogue on the score of safety, in those buildings where, accidentally, explosive mixtures may be formed. To the engineers of such works, this accident will be suggestive, and where necessary precautions will be taken."

I am, however, writing to give a short account of an occurrence which took place in a house in which I was staying last September. This house had recently been fitted up with incandescent electric lights. A bottle was being uncorked in the dining-room, when the cork flew out and struck one of the electric lamps. The glass bulb broke, and there was immediately a blaze of light, owing apparently to the formation of an arc, which fused the brasswork of the fitting, with the result that the molten metal fell down, lighted the table-cloth, and caused other damage.

It has struck me that this occurrence may be of interest at the present moment, and possibly assist Mr. Cotton in coming to a conclusion as to the manner in which the explosive mixture in his purifying house was ignited.

D. H. HELPS.

Gas-Works, Reading, Jan. 24, 1907.

Gas Fatality at Ealing.—On Sunday afternoon, some friends who called on Mr. and Mrs. Smart, at Lynton Avenue, Ealing, were unable to gain admission to the house; and on the police forcing an entrance, the couple were found lying dead on their bedroom floor, the place being full of gas. It is reported that the fatality was due to an escape from a sliding chandelier which had not been supplied with water.

Dispute at Bingley.—A disagreement has arisen between Messrs. R. Dempster and Sons, of Elland, and the Bingley Urban District Council in regard to the working of a combined charging and drawing machine; and the Clerk has been authorized to take legal proceedings against the firm for breach of contract. The penalty clause (which the Gas Committee recommended the Council to enforce), it is stated, provides for the forfeiture of £500 for breach of the contract, and for the payment of £2 per day for every day after the limit of time imposed in the contract.

The Pension Question at Oldham.—The suggestion of the General Manager (Mr. Arthur Andrew) that an old-age pension scheme should be instituted in connection with the Oldham Gas and Water Department, which was referred to in last Tuesday's "JOURNAL," has been before the Gas and Water Committee; but consideration of the question has been deferred. The Chairman (Alderman Johnson) said it seemed to him that a scheme should be devised by the whole Corporation, and not one particular Committee; but Mr. Andrew remarked that a start would have to be made somewhere. The Chairman replied that it was a universal question. Mr. Perkins inquired if it was a municipal or a national question. He considered it a national question, and one that ought to be taken up by the Government, which was the proper authority to deal with it. Mr. Wild, on the other hand, thought it was a matter that Trade Unions should consider. Mr. Andrew pointed out that they had men working on the road who were over eighty years of age]

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—KING'S BENCH DIVISION.

Friday, Jan. 25.

(*Before Justices* DARLING *and* PHILLIMORE.)

Colne Valley Water-Works Company v. Hall.

This was an appeal by the Company from a decision of the Judge of the Watford County Court; and they asked for judgment or for a new trial.

Mr. M'CALL, K.C., and Mr. ROBERTSON (instructed by Messrs. Murray, Hutchins, and Co.) appeared for the appellants; Mr. HORACE AVORY, K.C., and Mr. BARTLEY DENNIS (instructed by Messrs. Fisher and Stephens) represented the respondent.

Mr. M'CALL said the question raised was one of great importance to water companies, and it arose in this way: According to a small plan attached to the Judge's notes, in a road leading from Harrow, called the Northolt Road, there was a main the property of the appellants, and from it there was a pipe leading to a meter. From the meter it went some distance along an occupation lane, and from there into the defendant's premises, East Croft. For a certain distance down this lane the pipe was coloured red, and farther onwards green—the latter portion having been added when the defendant obtained the supply in 1892; and his contention was that the whole of this pipe, until it reached the defendant's house, was a communication pipe. He laid stress upon this, because there were a great many cases in which the distinction had not been borne in mind between a communication-pipe and a service-pipe. The portion of the pipe on which the present dispute arose was that from the main to the meter, which was just off the high road at the mouth of the occupation lane; and the question turned on the property in the pipe between the main and the meter. The Private Act constituting the Company was passed in 1873, and in 1885 they were authorized by another Act to take over the works, rights, and liabilities of the Harrow Water Company, also constituted under a Private Act; and from that time the Colne Valley Company carried on both undertakings—the place in question having been originally part of the Harrow Company's district. The Act of 1873 stated that parties wanting a supply of water must, at their own cost, provide and lay down and maintain all service-pipes and fittings which might be required within their premises, and the Company would lay down and fix the service-pipe to the boundary—all materials and labour being charged to the owner. The learned Counsel went on at great length to cite the various sections of the Private Act, and of the Water-Works Clauses Act, and also passages from the judgments in previous cases, laying special stress on the case of *Milnes v. Corporation of Huddersfield*, which went to the House of Lords, where it was decided that the whole of the communication-pipe, from the main to the consumer's premises, was the property of the consumer.* He submitted that not only was the whole of the pipe in question the property of the defendant, but that in any case he was bound to repair it. The learned Counsel read the correspondence that passed, in which notice was given to the defendant to repair the pipe, with which he did not comply; and ultimately the Company did the work themselves, and brought their action to recover the expense. He also read the Judge's notes and his judgment, in which he held that the pipe was the property of the Water Company, and that they were responsible for repairing it, and could not recover against the defendant.

Mr. AVORY submitted that the County Court Judge was right on both grounds—first, that there was no evidence before him that the piece of pipe which was out of repair was the property of the respondent; and, secondly, that if it was, the liability to repair it was not established either by the Special or the General Act. The action in the County Court was to recover the cost of the repairs which the Company had done; and as to a part of it, the evidence of those who did the repairs showed it was a repair to the plug-cock on the main, as to which it was quite clear that it was not a repair to any communication-pipe so as to come within any of the arguments which had been addressed to their Lordships. With regard to the other portion, which was actually on the bit of pipe between the main and the meter, he contended that no legal obligation on Mr. Hall was established by any of the sections. It was not necessary to argue the general question whether, as a rule, a communication or a service-pipe belonged to the consumer, because the facts of this case were altogether exceptional. It was clear from the facts that the pipe coloured red existed at the time when the Colne Valley Company took over the property of the Harrow Company, and even supposing that, under the old Act, the pipe belonged to some other consumer, as soon as he ceased to take the supply from it, and abandoned any property he ever had in it, the present plaintiffs, when they took over everything that belonged to the Harrow Company, also took over this piece of pipe connected with their main. This was the view that the County Court Judge had taken; but, apart from this, he submitted, and argued at some length, that there was no obligation on the consumer to repair any portion of a pipe which he had no opportunity of inspecting so as to see whether or not it was defective.

Mr. ROBERTSON having shortly replied,

Justice PHILLIMORE delivered the judgment of the Court, as follows: We think that *primâ facie* the property in this pipe, as in all other communication-pipes leading up to the main, would be in the consumer. There may be special facts in this case which would put the property in the Company instead of in the consumer. We do not think it very likely; but if and so far as the judgment of the learned Judge of the County Court rests on that—and it is one of the points he has taken—we think it would be necessary to have the matter further elucidated, and if that were the deciding ground, to have a new trial upon it. We also think that there is nothing in this case in the position of the meter. The pipe *primâ facie* is the consumer's pipe from beginning to end; and it is none the less the consumer's pipe because during some portion of its history the parties changed the ordinary mode of payment for water from assessment on the rateable value to payment by meter, and put a meter in. This would equally be the case in the first instance if the supply were by meter. It might very well be that the Highway Authorities objected to meters under the road, and that in all cases meters cannot be put nearer to the main than the nearest position on some property which is not on the highway. But we think it does not necessarily follow that, supposing the property in this pipe to be in the consumer—and for the purpose of the rest of our judgment we assume it is in him—the consumer is bound to repair it either under the General Act or under the Act of the Company. We think that the principles of the judgments of Lord Esher and Lord Justice Kay in *Chapman v. Fylde Water Company* (1894, 2 Q.B., 599) apply, and that the reasoning is such as we ought to follow, not necessarily regarding it as binding upon us, but taking it as sound reasoning which we ought to follow. We think that the consumer may have a right, and has a right under the Act of Parliament, as against the Highway Authorities, to open the highway once for all for the purpose of making the necessary communication with the main; but the Legislature very reasonably said that after that private individuals were not to be entitled to break up the highway, and that after the pipe had been first laid down the highway can only be broken up by the water company or other body having statutory powers for the supply of water in the district. This being the case, we think the consumer has not the power—he certainly has not got it expressly, and we do not think he has it by implication—to break up the road, either for the purpose of repair or for the preliminary purpose of inspection, to see whether or not the pipe is defective. We think that, this being the case, the only body which can open the highway is the water company, and that in the rare instances—because they will be rare—in which the portion of the pipe from the main to the edge of the highway gets out of repair, the duty of repairing that would naturally fall on the water company. We do not decide this case upon the ground suggested by Mr. Avory, that everything outside the consumer's premises must be repaired by the water company. We leave entirely open the question of what would happen with regard to the portion of the pipe which passes through the property of third persons—either closes or occupation roads; but with regard to the portion of the communication-pipe which passes under the public highway, we think that, inasmuch as the appellant Water Company alone have the right to break up the highway for the purpose of either repair or inspection, they, and they alone, are bound to repair, and that they, and they alone, must bear the cost of repair. There are strong points in support of this under the General Act, and a different point, equally strong, in favour of that contention under the Special Act. Under the General Act, the liability on the consumer, if there is one, does not depend upon notice. He is liable though he has no notice, and he is liable for that which not only he does not know, but which he cannot know because he cannot open the ground; and it would be an extremely strong view to infer that such a liability existed. Under the Special Act, it is quite true he is only liable after notice; but then we think that such a notice could not be given in respect of the piece of ground in question. The notice can only be given when the occupier "shall have permitted;" and we accept the argument that a man cannot be said to have permitted that which he could in no sense have prevented. Therefore, upon these grounds, we think that the learned County Court Judge was right in saying not that a piece of pipe which is outside the occupier's premises is necessarily repairable by the Company, but that the particular piece of pipe in question, which was entirely under the roadway, was a part which the Company must repair at their own cost. That is really the only contention raised on behalf of the occupier. The language of the learned County Court Judge, if it was intended to apply to anything more than the case before him, might have raised a very serious point—whether the whole of the pipe going down the occupation road was repairable by the Company or by the consumer. Our judgment does not touch that question. Personally, I may say for myself that I think the limit is not the consumer's premises but the public highway. At any rate, all that we decide to-day is that, as regards this piece of pipe which is under the public highway, there is no responsibility on the part of the owner to keep it in repair. Therefore the judgment in the Court below must be affirmed, and the appeal dismissed.

Mr. M'CALL asked leave to appeal.

Justice DARLING granted it.

Mr. AVORY pointed out that the appeal might mean an enormous sum to Mr. Hall, who, he said, was not interested in fighting the battle of the public; and he thought terms should be imposed on the Company if they wished to make this a test case.

* See "JOURNAL," Vol. XL., pp. 264, 1089, 1127: Vol. XLII., p. 887; XLVII., 496; and Vol. XLVIII., p. 107.

HIGH COURT OF JUSTICE—KING'S BENCH DIVISION.

Thursday, Jan. 24.

(*Before the* LORD CHIEF JUSTICE *and a Special Jury.*)

English v. Metropolitan Water Board.

This was an action brought by Lieut.-Col. English, a retired officer of the Royal Engineers, who in 1874 purchased a property at Hawley, near Dartford, in Kent, called "The Rookery;" and he asked for an injunction to restrain the defendants from polluting a stream which formed the boundary to one of his fields, by allowing refuse water, oil, and grease from their steam-engines and boilers to flow into it, and from unlawfully abstracting water from the stream. He also claimed damages for the injury already done.

Mr. TINDAL ATKINSON, K.C., Mr. FITZGERALD, K.C., and Mr. BAILHACHE (instructed by Messrs. Deacon, Gibson, Medcalf, and Marriott) appeared for the plaintiff; Mr. ELDON BANKES, K.C., and Mr. A. B. SHAW (instructed by Mr. Walter Moore) represented the defendants.

Mr. TINDAL ATKINSON said the defendants were successors of the Kent Water Company, who at the time the dispute arose had sunk a well and erected a pumping-station close by the stream in question,

which up to that time was a clear brook, running over a gravel bed, fed by springs in the chalk, was hardly ever dry, and ultimately found its way into the Darent. In fact, the river was the spawning-ground and breeding-place for the trout for which it was famous. The Kent Company sunk a well to the depth of 100 feet, and put down a borehole for another 130 feet; and the chalk brought up by these operations was allowed to pass into the stream, raising the bed about 18 inches—covering the gravel, making it unfit for trout, and forming a dam which diverted the stream. In addition, the pumping operations had the effect of abstracting the water from the stream to such an extent that it was often left practically dry; while the small quantity of water which was left in puddles was so polluted by the dirty, greasy water from the engines, that cattle would not drink it. The defendants took over the property from the Kent Company in 1904, and the pollution and abstraction of water went on, notwithstanding repeated complaints, until some time in 1906, when certain tanks and soakage pits were constructed. But the evidence would show that they were quite ineffective. With regard to the abstraction of the water, he admitted that if the defendants had simply tapped the springs in the chalk, and so prevented the water rising into the brook, the plaintiff, though he would have been injured, would have had no remedy. But if the water once reached a defined channel on the surface, then no one had a right to divert or abstract it to the detriment of anyone having riparian rights in the neighbourhood. That this was the case here would, he thought, be made quite clear, among other things, from the fact that when, in consequence of some accident, the pumping operations of the defendants were suspended for a time, the stream rose within 48 hours to its old level, and followed its original course. Steps were then taken to ascertain whether there was any loss of water in the channel from the place where the stream entered the defendants' premises to the point where it left; and there was no loss whatever, though up to that time, by tests taken, from one-half to two-thirds of the water had disappeared between the two points, and it was manifest that this could only occur in consequence of the pumps drawing it off through the underground porous strata. The question could be tested at any time by stopping the pumping operations. Counsel then proceeded to read the correspondence which passed prior to the action—beginning in March, 1905, with a letter from the Secretary of the Darenth Fishing Preservation Society, and continuing at intervals for about a year; the writ being ultimately served on March 17 last year. The principal case relied on with regard to the right to take water from a running stream was *Sugar v. Grand Junction Canal Company* (6 Ch.).

Friday, Jan. 25.

On the resumption of the case this morning,

Plaintiff was called, and his evidence, in which he went into all the circumstances in great detail, occupied the greater part of the day.

Colonel *Dale* was the next witness; he being a neighbour of the plaintiff.

The examination-in-chief of this witness had not concluded at the rising of the Court, when the case was adjourned to the 28th inst. (yesterday).

Liability of an Agent for Water-Rate.

Out of 117 claims for rates brought by the Metropolitan Water Board in the Westminster County Court on Monday last week, only one was disputed before his Honour Judge Woodfall. The question was whether the defendant, Mr. Letchford, a solicitor, who employed a collector, was liable for water-rate, or whether it was the collector, as the defendant contended. Mr. D. Collins, the Assistant-Solicitor to the Board, said the defendant was the nephew of the owner of property in the East London district, and acted for his uncle. He employed a collector, at 5 per cent. commission on the rents collected. The rateable value of the premises was under £20, and the East London Water Act contained a clause similar to one in the Water-Works Clauses Act which stated that in such cases the owners instead of the occupiers should be liable for the rate. He referred to the Act to show that an agent was liable in the East London district. The defendant contended that the "agent" in this case was the man who collected the rents. His Honour said he thought the defendant was liable; his case being the very one contemplated by the Act. The plaintiffs must therefore have judgment for the amount claimed, with costs.

Method of Charging for Water.

An action was brought in the Torrington County Court yesterday week, to test the legality of the charges made by the Corporation for water supplies. The defendant was a butcher named Slee; and the amount in dispute was £1 5s. 5d. It was stated that defendant was formerly a member of the Town Council; and it was alleged that, on paying the water-rate at Midsummer last, he told the collector that if he was defeated in November he should raise the question of the method of charging for water. The demand-note stated the charges to be for domestic supplies 1s. 2d. in the pound on the gross rateable value; for fields, 10d. in the pound; and for other items, such as baths, slaughter-houses, &c., at varying amounts. The question was whether the Town Council, who acquired the water undertaking in 1900, had a right to charge on the gross rateable value. Mr. Hopper, for the Corporation, admitted that if the case came under the portion of section 56 of the Public Health Act, 1875, which said local authorities may charge "a water-rate to be assessed on the net annual value of the premises," he was "out of court." But the section went on to provide that local authorities "may enter into agreements for supplying water on such terms as may be agreed on between them and the persons receiving the supply;" and he submitted that where a man took goods, that constituted on his part an agreement to pay for them. As Mr. Slee had for years past used the water and paid the charges, and in this particular quarter he took the water and gave no notice, Mr. Hopper contended that there was abundant evidence of an agreement on defendant's part to pay for it, as he had hitherto done. Mr. James, for the defendant, argued that there was a difference between a constructive agreement in the case of private individuals and one in which a body like the Corporation, acting under statutory powers, were concerned. Defendant was entitled to be assessed on the net annual value, in the absence of an agreement; and taking the water did not constitute an agreement. Defendant, who was called, said he had protested against the charge for eighteen months; but he had never given notice to the Corporation that he should discontinue taking their water, and had used it for the slaughter-house, carriage, and other purposes. His Honour Judge Beresford held that the Corporation came under the section, and that they could only assess the water-rate on the net value. The provision as to agreements did not apply, because no agreement had been entered into between the Corporation and the defendant. On the grounds that the rate had been wrong from first to last, and defendant had been fighting the case, not only for his benefit, but for the benefit of the public, his Honour allowed costs on the higher scale.

Gas Companies and Forged Cheques.

At Old Street Police Court, last Wednesday, a curious point was raised as to the liability of a gas company to refund money paid under the peculiar circumstances stated below. A man named Hartley, an accountant, was in the dock charged on a warrant with having forged and uttered a cheque for £27 12s. Mr. A. E. Robinson, who prosecuted, stated that, among other charges it was intended to prefer, were some in respect of two cheques which had been paid to the Gaslight and Coke Company for gas supplied to—it was believed—prisoner's own household. Hartley had been employed as clerk-accountant by a firm of tapestry merchants in Wells Street; and in this position he had full access to the cheque-book, pass-book, paying-in book, &c. He was discharged from his employment in October; and subsequently a communication to the firm led the latter to put a private mark on all cheques sent out. No others were to be cashed by the bank with which the firm kept their account. The cheque for £27 12s.—the subject of the charge—was presented about the end of December, and returned by the bank. Then an investigation showed that cheques had been removed from the firm's books, and (on forged signatures of the two partners) had been paid through the bank. They could not be traced; and it was presumed that the prisoner had destroyed them, and taken other steps to hide any account to which they might refer. Among these cheques were two, Mr. Robinson said, traced to the Gaslight and Coke Company, as having been received for quarterly accounts for gas. He should contend that the Company were liable to refund the money; and he proposed to take a subpœna *duces tecum* to compel the Company to produce their books, and, as the cheques could not be found, get the only available information from them. The point thus raised will no doubt be referred to again next week, when the prisoner comes up on remand.

Gas v. Electricity in Birkdale.

The Southport Corporation and the Birkdale Urban District Council are each endeavouring to convince the ratepayers of Ainsdale, which last year became a ward in Birkdale, of the respective merits of gas and electricity for lighting purposes. Birkdale is electrically lighted by the District Electric Supply Company; and Ainsdale, as well as Birkdale, is supplied with gas by the Southport Corporation through Birkdale mains. Recently the Birkdale Council decided to ascertain whether the Ainsdale ratepayers would prefer electricity to gas; and they caused a poll to be taken on the point. The Southport Gas Committee resented what they regarded as an attempt by Birkdale to promote the interests of a private Company at the expense of the Corporation estate; so they furnished the Ainsdale ratepayers with circulars showing the cheapness and superior illuminating power of gas as compared with electricity. The Birkdale Council deny that they are seeking the advantage of a private Company. One of their officials has announced that, though figures are not available, the Council are highly satisfied with the result of the poll, and that "there is a certainty of electricity being taken to Ainsdale when the Council are ready to proceed." Despite this declaration, the Southport Gas Committee view with complacency any scheme which may be mooted in this direction, because lively opposition has been aroused to the introduction of electricity.

London County Council Testing of Electricity-Meters.

The London County Council have laid down new rules and a scale of fees to be charged for the testing of electricity-meters. One of the rules is as follows: "In the case of meters which before being fixed shall have been tested by the Council and passed as correct, the meters will be tested for starting current and at one or more quarter loads; and if the results be approximately the same as those obtained in the previous tests, the meters will be considered correct. A meter shall be considered by the inspector to be correct if, being intended for currents not exceeding 3 amperes, the error at one-tenth of its full load and above this point does not exceed + or − 3½ per cent.; exceeding 3 amperes but not exceeding 50 amperes, the error at one-tenth of its full load and above this point does not exceed + or − 2½ per cent.; and exceeding 50 amperes, the error at one-twentieth of its full load and above this point does not exceed + or − 2½ per cent." It is specified that in the case of meters which have not been tested and sealed by the Council before fixing, the tests will be made at the average load used by the consumer, if this can be ascertained, except that in the case of meters intended for currents not exceeding 3 amperes, the tests will be made at one-quarter and three-quarters of the consumer's maximum installed load. The fees for testing single or disputed meters range from 10s. up to 20,000 watts capacity, to £2 10s.; rising by 10s. for each 20,000 watts.

The quarter's account for electricity consumed at the Acton Public Library was stated at last Tuesday's Committee meeting to be practically double the amount paid when gas was used.

MISCELLANEOUS NEWS.

GASLIGHT AND COKE COMPANY'S ACCOUNTS.

[For the Half-Yearly Report, see p. 270.]

The accounts of the Company for the six months ending Dec. 31, to be submitted with the Directors' report on Friday, consist of the usual statements, from which we take the following particulars.

The statement of capital (stock) sets forth that the total paid up is £9,466,500; added on conversion, £12,176,565—total amount authorized, £21,643,065. Deducting the amount redeemed, £40,090, the total amount of the Company's existing capital powers is £21,602,975. The statement of loan capital stands thus: Total paid up, £2,844,000; added on conversion, £1,479,975; unissued, £750,000—total amount authorized, £5,073,975.

The capital account shows receipts (with premiums, £1,586,807 11s. 9d.) to the amount of £27,513,757 11s. 9d. The expenditure is shown in the following items:—

Expenditure to June 30, 1906		£13,389,124 19 11
Expenditure during the half year to Dec. 31, 1906—viz.,		
On land	£11 4 3	
Buildings and machinery in extension of works	4,323 2 7	
New and additional mains and service-pipes	14,904 7 11	
Do. do. meters	28,186 12 1	
Do. do. stoves	22,076 8 5	
	69,501 15 3	
Total expenditure		£13,458,626 15 2
Nominal amount added on conversion		13,656,540 0 0
		£27,115,166 15 2
Deduct amount of capital redeemed under Company's Act of 1903		40,090 0 0
		£27,075,076 15 2
Balance of capital account		438,680 16 7
		£27,513,757 11 9

The balance applicable to the redemption fund and to dividend on the ordinary stock is £574,421 8s. 4d.; and the following statement shows how it is proposed to appropriate it.

Dec., 1905.			
£217,408	..	Net balance brought from last account	£210,481 3 9
308,802	..	Net revenue for the half year	363,940 4 7
£526,210			£574,421 8 4
10,000	..	Contribution to redemption fund	10,000 0 0
(£4 8s. per cent.)		Dividend on the ordinary stock—	
£334,911	..	£4 8s. per cent. per annum on £15,203,110	334,468 8 5
£181,293	..	Balance carried to next account	£229,952 19 11

The following is the revenue account:—

Expenditure.

Dec. Half Year, 1905.		£ s. d.	£ s. d.
	Manufacture of gas—		
£48,631	Coal into store	491,0 5 0 5	
85,151	Oil ,, less value of oil tar	77,627 5 8	
27,482	Coke and breeze used in the manufacture of carburetted water gas	31,012 16 0	
15,047	Salaries of Engineers and other officers	14,885 15 4	
109,015	Wages, gas making £50,492 10s. od.	104,984 3 4	
17,478	,, sundries £14,491 13s. 4d.		
41,634	Purification, including £12,767 2s. 4d. for labour	27,500 14 8	
183,918	Repair and maintenance of works and plant, materials and labour, less received for old materials, £7687 16s. od.	181,483 14 11	
	Distribution of gas—		928,309 10 4
41,261	Salaries and wages of officers (including Rental Clerks)	42,091 5 1	
59,430	Repair and maintenance of mains and service-pipes, &c.	69,998 13 10	
26,028	Repair and renewal of meters	27,173 17 5	
56,483	,, ,, stoves	45,420 10 11	
			184,684 7 3
18,341	Public lamps—lighting and repairing	..	19,401 7 8
	Rents, rates, and taxes—		
5,842	Rents payable	5,823 12 9	
148,824	Rates and taxes	136,742 19 5	
	Management—		142,566 12 6
2,750	Directors' allowance	2,750 0 0	
217	Company's Auditors and Assistant	200 0 0	
7,516	Salaries of General Manager, Secretary, Accountant, and clerks	7,782 10 8	
24,555	Collectors and Cashiers	22,620 2 11	
5,423	Stationery and printing	5,311 11 2	
3,527	General charges	4,733 13 8	
			43,397 18 5
1,629	Parliamentary charges	..	..
993	Law charges	..	1,055 17 6
1,388	Charges *re* quinquennial re-valuations	..	..
4,937	Bad debts	..	5,223 0 3
500	Depreciation fund for works on leasehold lands	..	500 0 0
	Annuities, including contribution to		
23,773	officers' superannuation fund	..	24,564 9 11
648	Workmen's compensation account	..	1,227 4 4
	Public officers—		
849	Gas Referees and Official Auditor	847 7 0	
632	Public testing-stations	999 18 0	
			1,847 5 0
£1,380,302			1,352,777 13 2
503,848	Balance carried to net revenue account		561,209 13 1
£1,884,150			1,913,987 6 3

Receipts.

Dec. Half Year, 1905.		£ s. d.	£ s. d.
	Sale of gas—		
£1,434,952	Per meter, at 2s. 11d. and 2s. 2d. per 1000 cubic feet	1,442,784 4 9	
68,970	Public lighting and under contracts	69,491 8 7	
			1,512,275 13 4
£1,503,922			
36,215	Rental of stoves	..	38,103 8 10
	Residual products—		
£203,220	Coke, less £32,023 16s. 9d. for labour, &c.	218,187 11 10	
14,233	Breeze, less £4241 5s. 10d. for ditto	12,093 16 2	
40,406	Tar and tar products	48,487 16 7	
81,240	Ammoniacal liquor and sulphate of ammonia	80,026 14 2	
			358,795 18 9
£339,079			
£4,641	Rents receivable		4,537 2 10
293	Transfer fees		275 2 6
£1,884,150			1,913,987 6 3

The three statements relating to the reserve, insurance, and depreciation funds show that the balances on Dec. 31 were as follows: Reserve fund, £62,304 2s. 10d.; insurance fund, £90,442 2s. 5d.; and depreciation fund, £63,296 14s. 10d.

The following statements relate to the working:—

Statement of Coals Used, &c.

Description of Coal.	In Store June 30, 1906.	Received During Half Year.	Carbonized During Half Year.	Used During Half Year.	In Store Dec. 31, 1906.
	Tons.	Tons.	Tons.	Tons.	Tons.
Common	132,919	899,037	805,473	1,743	224,740
Cannel	12,936	..	900	..	12,036
Total	145,855	899,037	*806,373	1,743	236,776

* In addition to this quantity of coal, 7,300,963 gallons of oil and 69,115 gallons of spirit were used during the half year.

Statement of Residual Products.

Description.	In Store June 30, 1906.	Made During Half Year.	Used During Half Year.	Sold During Half Year.	In Store Dec. 31, 1906.
Coke—tons	10,498	504,548	102,494	395,174	17,378
Breeze—tons	11,927	68,266	13,428	64,462	2,303
Tar, from coal only—galls.	631,461	8,107,645	7,884,447	15,720	838,939
Ammoniacal liquor—butts	18,315	233,232	229,784	..	21,763

Statement of Gas Made, Sold, &c.

Quantity Made.	Quantity Sold.		Total Quantity Accounted for.	Number of Public Lamps.
	Public Lights and Under Contracts. (Estimated.)	Private Lights (per Meter).		
Thousands.	Thousands.	Thousands.	Thousands.	
*11,288,134	472,670	10,211,254	10,803,847	49,596
†11,236,107	472,140	10,095,388	10,695,531	49,736

* Including 2,542,181,000 cubic feet of carburetted water gas. † Dec. half year, 1905.

The remaining statement is the balance-sheet, which gives the value of the stores in hand at the close of the half year as follows: Coal, £155,365; oil and petroleum spirit, £34,023; coke, £10,155; tar and ammoniacal liquor and products, £117,423; and sundries, £221,833. The figures this time last year were: Coal, £139,471; oil and petroleum spirit, £44,636; coke, £4485; tar and ammoniacal liquor and products, £86,518; and sundries, £231,175.

BATH AND THE SULPHUR QUESTION.

In presenting a report to the Bath Town Council on the Removal of Sulphur Restrictions Bill, 1907, which is being promoted by the Bath and other Gas Companies, the General Purposes Committee stated that, being satisfied (after reading reports by the Town Clerk, the Borough Analyst, and the Medical Officer of Health) that opposition to the Bill was not likely to be of any use, they could not recommend the Council to take any steps in the matter.

When the report came before the Council, the Chairman (Mr. J. W. Knight) asked the City Analyst (Mr. J. W. Gatehouse) if he could give any explanation with reference to his report on the subject. Mr. Gatehouse replied that, so far as he could understand it—and he was not quite certain he did understand the whole effect of it—the application of the Company was that they should not be compelled to extract any sulphur from their gas other than that which was present in the form of sulphuretted hydrogen. The Gas Act under which the Company at present worked permitted them, he believed, to retain as much as 30 grains of sulphur per 100 cubic feet, which was by no means, in his estimation, non-prejudicial. He could not imagine that they would get any worse results than they were obtaining at the present time; but he thought the Company should have been compelled years ago to have taken out far more than they did, for the benefit of the consumer. In answering Alderman Mitchell, as to whether the colour of the gas would be improved, Mr. Gatehouse said

gas was not now manufactured in the same way as when the Bath Gas Acts were passed. Now they not only used coal, but oil also. In the present day, not merely in Bath, but all over the country, there was a great deal more carbon monoxide in gas than formerly; and carbon monoxide was a very deadly poison. Any person could very easily commit suicide by taking gas as it came from the mains and breathing it. He could only suggest that it would be very desirable if the amount of carbon monoxide could be limited.

The Chairman said he thought it would be very advisable, in the light of these statements, that the matter should be considered in consultation with Mr. Gatehouse and the Medical Officer of Health; and this was agreed to.

TESTING BIRMINGHAM GAS IN KING'S NORTON.

The Birmingham Gas Committee, in a report which will be submitted to the next meeting of the City Council, point out that the King's Norton and Northfield Urban District Council are promoting a Bill, clause 212 of which reads as follows:—

(1) The Council may cause to be provided at such place or places within the district as they shall deem most convenient for the purpose a testing place or places, with apparatus therein, for the purpose of making the following tests of the gas supplied within the district by the Corporation of Birmingham, or any other body of persons for the time being empowered to supply gas within the district (in this section referred to as the undertakers). That is to say: (*a*) For testing the illuminating power of the gas supplied; (*b*) for testing the presence of sulphuretted hydrogen in the gas supplied.

(2) Any gas examiner appointed by the Council in pursuance of the Gas-Works Clauses Act, 1871, may carry out the tests provided by the said Act at any place provided by the Council for that purpose under this section; and any such test there and then made by the gas examiner, and his report of the results of his testing, shall be receivable in evidence in the same manner, and shall be of the same effect in all respects, as if such test had been made at the place provided by the undertakers in pursuance of the said Act.

The Committee remark that the districts of King's Norton and Northfield are within the area supplied with gas by the Corporation. Under section 28 of the Gas-Works Clauses Act, 1871, and section 156 of the Birmingham Corporation (Consolidation) Act, 1883, the Corporation have to provide a testing-place for testing gas at each of their gas-works. By section 29 of the Act of 1871, the local authority of any district where the gas is not supplied by such local authority may from time to time appoint, and may appoint and keep appointed, a competent and impartial person to be a gas examiner, to test the gas at the testing-place provided in conformity with the provisions of the Act; and such gas examiner may there test the illuminating power and purity of the gas supplied by the Corporation any day between the hours of 5 o'clock and 10 o'clock in the afternoon from Oct. 1 to March 31, and on any day between the hours of 8 o'clock and 11 o'clock in the afternoon from April 1 to Sept. 30. The King's Norton and Northfield Urban District Council, by their Bill, seek power to provide a testing place or places within their district; and, after careful consideration, the Committee are of opinion that the Bill should be petitioned against and opposed in Parliament.

The Committee therefore recommend that the Town Clerk be authorized to petition against the Bill.

SWADLINCOTE GAS SUPPLY.

A Special Meeting of the Swadlincote Urban District Council was held last Tuesday—Mr. B. Goodhead, J.P., presiding—when Alderman Hart, of Derby, who had been engaged to audit the accounts for the year ending March 31 last, was present, as also was Mr. J. Ferguson Bell, the Manager of the Derby Gas-Works, to explain the report which, as has already been stated in the "JOURNAL," he was asked to prepare in regard to the accounts. In his report, Alderman Hart, after adjusting the stocks, brought out a balance of profit (to be devoted to the free-fittings system) of £971.

In his report last week, Alderman Hart said that, in consequence of the way in which the accounts were made up, it was difficult to ascertain the profit actually earned during the year under review, as the cash transactions were taken and the stocks valued at the commencement and the end of the year, instead of a revenue account being prepared with allowances made for difference in stocks, when the value of stocks held would be shown in a general balance-sheet. He strongly recommended the Committee to alter the system of keeping the gas accounts, and bring them into conformity with the style prescribed by the Gas-Works Clauses Act of 1871; so that the annual statement might, in future, correspond with the Model Schedules. The outstanding loans on capital expenditure amounted to £64,743, upon a total sale of gas of 35 million cubic feet, or nearly £1850 per million—a sum far in excess of what was generally considered a moderate capital even for small gas undertakings. The average capital employed per million feet of gas sold (according to the last published returns in "Field's Analysis") of nine large corporation gas undertakings was £555, which was less than one-third of that employed at the Swadlincote Gas-Works; and if allowance was made for the concern being much smaller, it was evident that the undertaking was over-capitalized, which compelled him to recommend that all expenditure should as far as possible be charged to revenue. The interest charges of £1972 and repayments on capital accounts of £1081, totalled £3053 for the year, which was equal to 1s. 9d. per 1000 cubic feet of gas sold. This proved that if gas was to be sold cheap, it would be necessary to reduce the heavy capital charges.

Mr. Stevens moved the adoption of the report, and wished to know whether the sum of £1800 advanced out of the rates should be treated as a loan to the gas accounts. Mr. Howard seconded, and stated that the Council were supplying gas to large consumers at 3s. 6d. per 1000 cubic feet, which cost 3s. 6½d. to make. Mr. Wragg was of the opinion that the capital account should be reduced and the quality of gas improved to meet the requirements of the district. Mr. Bell recommended that boiling-burners should be fixed in houses where cookers were in use, which would increase the consumption of gas. The Clerk stated that the Council had taken a loan of £3000, repayable in ten years, for mains and extensions, and that they had an overdraft of £2000 for free fittings, which would have to be paid. Alderman Hart suggested that it should be augmented to £5000. Mr. Wragg strongly objected, and said it was useless to take up a loan of £10,000 for ten years, as the money would have to come out of the rates. Mr. Stevens said the outlook did not warrant any further expenditure, as the income per slot meter, which in 1905 averaged £2 0s. 8d., had fallen to £1 17s. 10d. in 1906, and the sale of gas had gone down 100,000 cubic feet. Alderman Hart reminded the Council that in case another loan was wanted it had better be taken for five years and repaid annually from the profits. Mr. Wragg maintained that no profits had been made, and no money was available from that source.

Mr. Belfitt, the Chairman of the Lighting Committee (who announced his intention to resign), said, in reply, that the report was a plain and sensible one, and must be the basis for the management of the gas-works. But he was interrupted with the remark that it did not show any profit. Continuing, he said, if there were no profits, where did the stock come from? Mr. Underhill: It has come from the overdraft. The Chairman pointed out that a man should be kept to look after the leakages. With respect to the income, he was pleased to know that 1000 houses were using slot meters, and to increase the consumption an outlay of £3000 was wanted to connect as many more houses in other parts of the district.

The report was adopted; and in responding to a vote of thanks, Alderman Hart said that, though the gas-works had a burden of £65,000, he was confident that, with the enlargements now completed and the extension of the free-fittings system, the Council would have no cause to be disheartened.

A TALK ON GAS MATTERS TO WORKING MEN.

At the Lyndhurst Hall, Kentish Town, last Tuesday, a large number of working men assembled to hear a "talk" by Mr. Ede on "Coal Gas: Its Rise and Development, and Its Uses." A short time since a "talk" had been given to the men on electricity; and it was thought only fitting that the benefits of the "rival illuminant" should be expounded to the members of the Institute.

Mr. Ede commenced with the introduction of gas more than a hundred years since, and the early experiments of Murdoch in 1791–2. He said that in 1807 gas was used as an illuminant in London for the first time; and companies were formed for its manufacture. The retorts were vertical cast-iron cylinders, filled with coal and heated to redness in a furnace. The ascending vapour passed through a trough of water (which, to a certain extent, freed the gas from both tar and ammonia), and was eventually collected in holders some distance away. It was not long before improvements were made, which resulted not only in a better quality, but a greater yield, of gas. These improvements in the retorts went on until a fairly definite candle power could be obtained, and the success of the "new illuminant" was assured. Chemists then began to interest themselves, and were not long in discovering that gas made from other substances could be used for illuminating purposes—such as from wood pulp, and even from sewage. But as the chemists had not another Murdoch to make their appliances for manufacturing these gases, they were, after a time, dropped. In 1810, in London, the Chartered (or Gaslight and Coke Company) was formed to supply the City and Westminster, the Phœnix (or South London Company) in 1816, the City of London Company in 1817, the Imperial Company in 1820, the Ratcliffe Company in 1823, and the Independent Gaslight and Coke Company in 1829. Between the latter date and 1835, a number of other Companies came into being—the London Company in 1830, and the South Metropolitan Company in 1833, both on the south side of the Thames—and a certain amount of free competition existed. In 1823, the selling price of gas was 15s. per 1000 cubic feet, which was gradually reduced to 13s. 6d. in 1830, to 12s. 6d. in 1832, to 10s. in 1836, and to 4s. in 1853, owing to competition. The Companies, however, came to their senses, from a "self-preservation" point of view, and made agreements with each other. They thus created a practical monopoly, and raised the price of gas to 6s. per 1000 feet. This continued about thirteen years.

During this period, an agitation was started by Mr. Charles Pearson, the City Solicitor of that day, and Mr. John Thwaites, a draper of the Borough (who afterwards became Sir John Thwaites), the result of which was the immediate starting in South London by Mr. Thwaites of the Surrey Consumers' Gas Company, and in the City of the Great Central Consumers' Company by Mr. Pearson. Both Companies were to supply at 4s. per 1000 cubic feet. The result of this was that the other Companies had to lower their prices to 4s. In the City, the Great Central Consumers' Company secured the contract for lighting the streets in 1850, and saved the citizens £730 in that year, but not without inconveniencing the public by the opening of 1650 holes in the streets. Agreements to divide the Metropolis into districts, to prevent competition, were sanctioned in 1860 by the Metropolis Gas Act; the result being that the price again advanced to 4s. 6d. But this Act, which gave so much to the Gas Companies, laid down a principle which is in force to-day—that Gas Referees should be appointed, with stringent powers relating to the testing of the gas. Two very important Acts were passed in 1868—one called the Gaslight and Coke Company's Act, and the other the City of London Gas Act. The former enabled the Chartered Company of 1810 to annul its Charter, and enabled various amalgamations to take place; the result being that the Imperial Company's price was fixed at 3s. 9d. per 1000 feet, the South Metropolitan Company's at 3s. 6d., the Gaslight and Coke

Company's at 4s., and the Commercial Company's at 4s.—with power of appeal to the Board of Trade for an alteration. In 1876, the sliding-scale was introduced.

The speaker closed his brief account of the Metropolitan gas supply by a few words upon the gas undertakings in the United Kingdom at the beginning of the present century. There were then 661 authorized gas undertakings, using 13 million tons of coal annually, and producing some 140 thousand million feet of gas, with an authorized capital of £83,000,000, the market value of which was something like £200,000,000. Of these 661 undertakings, 222 belonged to local authorities. There were also over 1000 non-statutory undertakings, of which they had no accurate knowledge. Figures like these told their own tale, and showed not only the enormous development of gas engineering enterprise, but its widespread and national importance.

Mr. Ede then gave a very graphic description of a testing-place, setting out and explaining the various means used for testing gas for impurities and illuminating effect. He afterwards dealt with residuals, and gave directions for reading a meter, and hints on pressure, governors for burners, and the use of bye-passes. After some remarks on incandescent lighting, the speaker said he thought finality had been reached in mantles, and improvements must now be sought for in burners. He described various burners, and said great harm was being done to incandescent gas lighting by the many cheap burners now on the market, owing to the expiration of the Welsbach patents. Better results could be obtained from the old type of Welsbach "York" or "C" burner than from many of the modern burners; and if consumers would pay a good price for a thoroughly good burner, they would find it the cheapest in the end.

At the close of the "talk," time was allowed for questions; and in the course of his reply, Mr. Ede said he was indebted to Mr. W. J. Liberty for the historical portions of the paper relating to the London Companies.

GAS SUPPLY IN JAPAN.

Osaka Gas Company.

In the "JOURNAL" for the 25th ult., we gave a short history of the gas-works of the city of Yokohama, which were the first of the kind in Japan. From the last number to hand of the "American Gaslight Journal," we take the following particulars in regard to the Osaka Gas Company, which is believed to be the first public service company in that country to be controlled by a foreigner.

Osaka is variously referred to as the Liverpool, Manchester, and Venice of Japan; and the scheme to establish gas-works there was originally suggested by Mr. Alexander Tison, a New York gentleman, and at one time a professor in the Tokyo University, to Mr. A. N. Brady, the American capitalist. In 1901, Mr. Brady, with Mr. Carroll Miller, who at present holds office as First Vice-President and Chief Engineer of the Company, made their first visit to Japan in connection with the project, though the matter had been under consideration since 1896. The following year (1902), active operations were commenced; the controlling interest having passed into Mr. Brady's hands, and the capital increased to 4,000,000 yen. For the next two years the construction and main-laying work went steadily forward; and finally, in October, 1905, the supply of gas was turned on. The plant at present in use has a capacity of 1 million cubic feet per day; but the demand has quickly outgrown the original estimate of the founders, and steps are now being taken to increase the output of the works. Only coal gas is produced. The manufacturing plant consists of full-depth regenerative furnaces with horizontal retorts of the most modern design, and the other plant and appliances are also of the latest and most improved type. At the commencement of this year the Company had more than 50 miles of mains running through the streets; and they are being rapidly increased. The apparatus and materials were purchased in various countries. The majority of the cast-iron piping came from America; the works apparatus from Germany; and the consumers' meters, wrought-iron piping, &c., from the United States. The building material and some of the cast-iron pipes were bought in Japan; and the greater part of the fittings and appliances sold by the Company have, up to the present, been of Japanese make. The Company possess a very enterprising directorate and Chief Engineer; and in their offices, which are located in a building such as one would expect to see in a European city, they have on view some of the most up-to-date systems of gas lighting. The result has been that the undertaking has developed in a remarkable way since operations were commenced.

METROPOLIS WATER SUPPLY.

London County Council and the Water Board's Bills.

At the Meeting of the London County Council to-day, the Parliamentary Committee will present a report on the subject of the Bill promoted by the Metropolitan Water Board to establish a uniform scale of charges for water applicable throughout the Board's area of supply, of which an epitome appears in another part of the "JOURNAL" to-day. The Committee explain that section 15 of the Metropolis Water Act, 1902, provides that the Board shall introduce a Bill for the purpose named within three years from June 24, 1904. The main proposal of the Bill is that there shall be a single uniform rate of 5 per cent. on all values to cover the whole of the domestic supply, and that no charges for extras shall be made except for garden watering. The Bill also proposes that the basis of the charge for domestic supplies shall in future be the rateable value of any house as appearing in the valuation list. At the present time, this is the basis in the County of London, as the result of the Water-Rate Definition Act, 1885. In the extra-London district, rateable value is not the basis, but the annual value, under the provisions of the Water-Works Clauses Act, 1847. This figure—*i.e.*, the annual value—is, as a rule, higher than the rateable value appearing in the valuation lists, as, owing to there being no periodical re-valuation in these districts as there is in London, the assessment very frequently falls below what it would be if periodically re-valued according to the London scale. The present practice of charging water-rates, therefore, is in the direction of equality between London and the extra-London district; but if the proposal of the Bill is adopted, it will have the effect of transferring some part of the burden from the extra-London district to London. The Committee point out that this would intensify any existing inequality. There are other important questions raised in the Bill which require consideration. They have accordingly appointed a Sub-Committee to consider its provisions, who will report to the Committee in due course. In the meantime, having regard to the inequality that must arise in consequence of the proposed alteration in the basis of charge as between London and the extra-London districts, they think the Council should lodge a petition against the Bill, not from the point of view of objecting to the main proposal, but in order to call attention to this inequality, with the view of having the Bill amended. The Water Board's estimate of the loss by the reduction of the basis of assessment is upwards of £10,000 per annum. This figure, however, would be considerably increased if the Board had fully exercised their existing powers to revise the charges in the extra-London district. The Committee recommend that petitions be sealed and presented against the Metropolitan Water Board (Charges, &c.) Bill, and the Metropolitan Water Board (Various Powers) Bill.

VIENNA WATER SUPPLY.

Frequent references have been made to the above subject in the Engineering Supplement to "The Times;" and in a recent issue some further particulars were furnished from the local correspondent of that paper, who obtained his information from a report made by the Municipal Inspector (Herr Bodenschor) on the mode of apportioning among the various areas the water derived from the new high-level service named after the Emperor Franz Josef. It appears that the total supply is estimated at 74·33 million gallons daily; being 30·33 million gallons from the one branch of the service and 44 million gallons from the other. Taking a daily volume of 22 gallons per head, the supply of water would suffice for a population of 3,380,000 inhabitants; and, according to statistical estimates, the population of Vienna would reach this total in the year 1940. It may, therefore, be assumed that the present works will suffice for the needs of Vienna until that date. Calculations as to the density of the population in the separate quarters of the city lead to the conclusion that in the parts now supplied, having an area of about 28,047 acres, a volume of some 70,840,000 gallons will be required in 1940; leaving the balance of 3,520,000 gallons available for certain high-lying districts of the city, which have at present no supply, and the area of which amounts to about 3460 acres.

Since it is not at present practicable to arrange fully for future requirements, it will be necessary later to construct two new reservoirs supplementary to those now in use. In the new quarters of the city to be added eventually, there will be a division into two zones—a high-level area and the summit-level area. The first will comprise in all a surface of about 2051 acres, and the latter an area of about 1409 acres. It will be possible in the former district to supply water by gravitation up to a height of 984 feet above sea level, while the rest of the water must be pumped. In consequence of the peculiar contours of the summit zone, it was found necessary to divide it up into several minor areas, and to provide three reservoirs at levels of 1040, 974, and 958 feet respectively above datum. It is proposed later to construct six smaller reservoirs at levels of 1312, 1247, 1345, 1312, 1214, and 1640 feet respectively. The new conduit, or the second Franz Josef supply, as it is termed, will be united to the district to be served by means of two mains. One of these, after passing a regulating chamber, to remove the pressure, will be joined to the existing mains, and the second will be reserved for the two highest zones. The new scheme provides in all for eleven reservoirs, with a total capacity of about 17,820,000 gallons. The mains will have a length of about 25½ miles; and their diameters will range from 43·3 inches down to 3·9 inches.

Motor-Buses and Public Lamps.—The Works Committee of the Westminster City Council presented a report, at the meeting of the Council last Thursday, to the effect that they had had under consideration accounts for repairs to public lamps damaged by vehicles. They said many of the breakages were caused by motor omnibuses skidding; and it had been held by the High Court that if an omnibus had all the usual and normal improvements, the owners could do no more, and were only liable when they or their servants were guilty of negligence. In eleven out of nineteen cases the owners had offered to pay half the cost, in settlement; and the Town Clerk had accepted the offers. The Committee approved of this action.

Water Supply to London Laundries.—A meeting called by the Launderers' Association, Limited, was held in the Holborn Restaurant last Wednesday evening, for the purpose of discussing clauses affecting the laundry industry contained in the Metropolitan Water Board (Charges, &c.) Bill. Mr. C. Marshall, the President of the Association, occupied the chair. Mr. T. Taylor said that, according to the scale suggested by the Board, the charge would be, according to consumption, from a maximum of 1s. down to 7d. per 1000 gallons, with a compulsory charge for a meter. Compared with returns he had received of present charges, this meant in some cases an increase of 50 per cent., though in other cases there would be a saving. The Board estimated an increased revenue of £43,496 from the new charges for non-domestic purposes; and while there was proposed a reduction for domestic supply of 0·06 per cent., and to public bodies of 12·33 per cent., the average increase for non-domestic supply would be 11·4 per cent. He strongly protested against the way in which the Board were seeking to escape from the obligations imposed on their predecessors. Resolutions were passed authorizing the Council of the Association to co-operate with the representatives of other trades in opposing the Bill when in Committee.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The expression may be somewhat hackneyed, but it is the most accurate description which can be given of the visit of the Western Juniors to the Bonnyside Fire-Brick Works of Messrs. James Dougall and Sons, Limited, this afternoon, that it was most instructive. It being the case that the construction of furnaces and flues is of prime importance in gas-works, and that material must be used which will withstand the high heats employed, a visit to a fire-brick manufactory could not fail to be the means of conveying much information regarding many points upon which there might have been preconceived notions that did not altogether quite conform to reality. The visit disclosed the care with which the clay is prepared, and the ease and simplicity of the appliances by means of which it is made into the desired shapes and sizes; but it also revealed how, though it is easy to mould the clay into almost any peculiar form, there are many risks to be run before some of the special designs of pieces can be satisfactorily fired, and that therein lies the explanation of how the price of specially designed goods is necessarily higher than those of ordinary shape. In the kilns, too, there was a great deal to be learned about the construction of flues, including the arrangements for the admixture of gases, and the direction of the flame so as to produce a uniform heat all over the interior of the oven. There was no stint in the showing of everything about the works which might be of interest to the visitors, even to the process of winning the clay from the huge underground hole designated the pit. It was the desire of the proprietors and of the management that everything should be seen; and this fulness of description led to the proceedings at the end being somewhat hurried, in order that the members of the Association might catch their train for Glasgow. The entertainment of the visitors by the Company, after the works had been inspected, was of the most sumptuous description. The paper by Mr. E. M. Stewart, upon "Fire-Bricks and Retorts" contained quite a mine of information; and the members were not slow to express, both in public and in private, their appreciation of it, and their conviction that it will be of great use to them.

The late Mr. William M'Crae, of Falkirk, was a personal friend of my own, and though his death at the age of 43 leaves a blank which is all the greater in that it has come so soon, it cannot be said that it has come altogether unexpectedly, for his condition of health, and the nature of his trouble, pointed to an early dissolution. It is to be remembered that his brother—the late Mr. John M'Crae, of Dundee—also died of heart disease, and at the early age of 44 years; so that the disease seems to have been of hereditary nature. When Mr. M'Crae presided at the Informal Meeting in Glasgow last April, his Convener was apprehensive of a breakdown in the course of the meeting, and he never left his side—a situation which would not have added to the comfort of those present if it had been known. It was immediately after that meeting that he was obliged to seek repose. He had not been in robust health since; and it is more than probable, from the fact that he resigned his situation a month ago, that he felt his life to be more precarious than it appeared to be to his friends. He had not been without his troubles, both at Dundee and at Falkirk. Indeed, on the day of his death, Mr. A. Wilson, of Glasgow, was in Falkirk inspecting the gas-works; there being, it is reported, some trouble with the foundation of the retort-bench. These worries, no doubt, told upon Mr. M'Crae, and hastened his end. He will be remembered as a gentleman of kindly and cheery disposition; and he has the reputation of having been the most pleasant of men to serve. When the Scottish Junior Gas Association was instituted, he took great interest in it, and was appointed an Honorary Member of both Districts.

The Watching and Lighting Committee of the Glasgow Town Council recommend that, in the event of any owner of a common stair desiring it to be lighted, the net charge be, in the case of incandescent gas, at the rate of 13s. 6d. per light, and in the case of incandescent electric light, at the rate of 15s. 6d. per light; the lamps to be subject to the approval of the Inspector of Lighting. In the Town Council on Thursday, Mr. Barrie asked whether, in view of the fact that the department had agreed to fix up incandescent gas-burners on common stairs, the same opportunity would be given to owners of private streets to fix incandescent burners on street-lamps, and, if so, at what extra cost. Bailie Hunter replied that the proprietor or proprietors of private streets could have incandescent gas-burners fitted in lamps on payment of the following extra charges over the statutory charge of 15s. per annum: Cost of providing burner, 3s.; annual extra charge for gas, 6s. 10d.; annual cost of maintaining mantles, 4d. each; and funnels, 2d. each.

The Gas Committee of the Falkirk Corporation have further reduced to four the short leet of applicants for the post of Gas Engineer and Manager, the gentlemen who have been left in being: Mr. J. M'Leod, of Glasgow; Mr. W. Wilson, of Kirkintilloch; Mr. T. Lighbody, of Renfrew; and Mr. J. Lang, of Fraserburgh. The appointment is to be made next Tuesday.

The Corporation of Wishaw have received an application from a firm of manufacturers for a supply of gas to work a 100 H.P. gas-engine. They have agreed to lay a 6-inch main to the burgh boundary, upon condition that the firm continue the same to their works.

The Town Council of Kirkcaldy had before them at their last meeting the report as to the lighting of the burgh, a summary of which I gave a month ago. The author—the Inspector of Lighting—stated that during the past ten years much had been done to improve the lighting of the burgh, by shortening the distance between the respective lamps, replacing ordinary burners by incandescents, and lighting the tramway route, with the exception of St. Clair Street, by electricity. The incandescent lighting was first installed in 1900, when twelve anti-vibration frames, with "C" burners were fitted into the ordinary lamp globes, and since then the number had been increased yearly, until it had reached a total of 672; and the Town Council have agreed to a gradual displacement of the remaining 352 ordinary burners by incandescents. During the past five years, experiments have been made with various kinds of incandescent burners; and after a sufficient test, the No. 2 Kern, consuming about 2 cubic feet per hour, has been found most economical, and has given the best results. . . . Of the 672 lamps fitted with incandescent burners, 338 consume 3 cubic feet of gas per hour; 144 consume 2½ cubic feet; and 190 consume 2 cubic feet. There are 1024 gas-lamps and 104 electric arc lamps. The cost for the year ending May 15, 1906, was: For gas, £1604; and for electricity, £1248. The cost per mile was: For gas, £56; and for electricity, £277. Appended was a report by Mr. H. O'Connor, F.R.S.E., of Edinburgh,

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 268.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Oct. 12	10½	Alliance & Dublin 10 p.c.	20½–21½	..	4 17 8
245,112	10	,,	7½	Do. 7 p.c.	14–15	..	5 0 0
200,000	5	Nov. 14	7	Bombay, Ltd.. . . .	6¼–7¼	..	4 16 7
40,000	5	,,	7	Do. New, £4 paid	5–5⅛	..	5 1 10
50,000	10	Aug. 30	14	Bourne-mouth Gas and Water } 10 p.c. . . B 7 p.c. . Pref. 6 p.c.	28–29	..	4 16 7
51,810	10	,,	7		17–17½	..	4 0 0
53,200	10	,,	6		15–16	..	3 15 0
380,000	Stk.	Aug. 15	12½	Brentford Consolidated	262–267	..	4 13 8
300,000	,,	,,	9½	Do. New . . .	200–205	..	4 12 8
50,000	,,	,,	5	Do. 5 p.c. Pref. .	120–125	..	4 0 0
206,250	,,	Dec. 13	4	Do. 4 p.c. Deb. .	101–104	..	3 16 11
220,000	Stk.	Sept. 27	11¼	Brighton & Hove Orig.	232–237	..	4 14 11
246,320	,,	,,	8¼	Do. A. Ord. Stk. .	163–168	..	4 18 3
460,000	20	Sept. 27	10	British	42–43	+½	4 13 0
104,000	Stk.	Aug. 15	6	Bromley, Ord. 5 p.c. .	121–125	..	4 16 0
165,700	,,	,,	4½	Do. do. 3½ p.c. .	91–94	..	4 15 9
500,000	10	Oct. 12	7	Buenos Ayres (New) Ltd.	11½–12	..	5 16 8
250,000	Stk.	Dec. 13	4	Do. 4 p.c. Deb. .	94–96	..	4 3 4
150,000	20	July 12	8½	Cagliari, Ltd.	24–26	..	6 6 11
100,000	10	Sept. 27	10	Cape Town & Dis., Ltd.	14–15	..	6 13 4
100,000	10	Oct. 26	4½	Do. 4½ p.c Pref.. .	9–9½	..	4 14 9
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	50–52	..	5 15 5
50,000	Stk.	Dec. 28	4½	Do. 4½ p.c. Deb. Stk.	96–98	..	4 11 10
157,150	Stk.	Aug. 15	5	Chester 5 p.c. Ord. . .	108½–110½	..	4 10 6
1,443,280	Stk.	Aug. 30	5⅝	Commercial 4 p.c Stk. .	110–113	..	4 12 0
560,000	,,	,,	5	Do, 3½ p.c. do. .	107–110	..	4 10 11
475,000	,,	Dec. 13	3	Do. 3 p.c. Deb. Stk.	83–85	..	3 10 7
800,000	Stk.	,,	6¼	Continental Union, Ltd.	124–127	..	5 2 4
200,000	,,	,,	7	Do. 7 p c, Pref.	138–143	..	4 17 11
432,070	Stk.	Aug.	5½	Derby Con. Stk. . . .	122–124	..	4 8 9
55,000	,,	July	4	Do. Deb. Stk. . . .	105–107	..	3 14 9
485,090	10	July 27	11	European, Ltd. . . .	24½–25½	..	4 6 3
354,060	10	,,	11	Do. £7 10s. paid	18–19	..	4 6 10
15,203,110	Stk.	Aug. 15	4⅘	Gas-light and Coke } 4 p.c. Ord. . . 3½ p.c. max. . . 4 p.c. Con. Pref. 3 p.c. Con. Deb.	100–102	..	4 6 3
2,600,000	,,	,,	3½		50–92	+1	3 16 1
3,709,735	,,	,,	4		107–110	..	3 12 9
4,193,975	,,	Dec. 13	3		84–86	..	3 9 9
258,740	Stk.	Sept. 13	5	Hastings & St. L. 3½ p.c.	98–103	..	4 17 1
82,500	,,	,,	6½	Do. do. 5 p.c.	118–121	..	5 7 5
70,000	10	Oct. 12	11	Hongkong & China, Ltd.	19½–20½	..	5 7 4
4,940,000	Stk.	Nov. 14	8	Imperial Continental .	181–184	+5½	4 7 0
473,600	Stk.	Aug. 15	3½	Do. 3½ p.c. Deb. Red,	95–97	..	3 12 2
183,242	Stk.	Aug. 30	6	Lea Bridge Ord. 5 p.c. .	120–125	..	4 16 0
306,083	,,	Dec. 28	4	L'rpool Unit'd Deb. Stk.	108–110	..	3 12 9
£			p.c.				£ s. d.
561,000	Stk.	Aug. 30	10	Liverpool United A . .	226–228	–1	4 7 9
718,100	,,	,,	7	Do. B. .	167½–163½	..	4 3 1
144,140	Stk.	Sept. 13	7⅞	Maidstone 5 p.c. . .	145–150	..	5 1 8
75,000	5	Nov. 29	5	Malta & Medn., Ltd. .	4¼–4¾	..	5 5 3
560,000	100	Oct. 1	5	Met. of } 5 p.c. Deb..	101–103	..	4 17 1
250,000	100	,,	4½	Melbourne } 4½ p.c. Deb.	101–103	..	4 7 5
541,920	20	Nov. 14	3⅛	Monte Video, Ltd. . .	11½–12⅝	..	5 12 0
1,675,892	Stk.	Aug. 15	4⅝	Newc'tle & G'tesh'd Con.	110–111	..	4 3 4
406,625	Stk.	Dec. 28	3½	Do. 3½ p.c. Deb.	96–97	..	3 12 2
15,000	10	Aug. 30	10	North Middlesex 10 p.c.	20–21	..	4 15 3
55,940	10	,,	7	Do. 7 p.c.	13½–14½	..	4 16 7
300,000	Stk.	Nov. 29	8	Oriental, Ltd. . . .	150–155	..	5 3 3
60,000	5	Sept. 13	7	Ottoman, Ltd. . . .	6–6¼	..	5 7 8
398,490	5	Oct. 26	7	Primitiva Ord. . . .	7⅞–8¼	..	4 6 2
796,980	5	July 27	5	Do. 5 p.c. Pref. .	5¼–5½	..	4 10 11
488,900	100	Dec. 1	4	Do. 4 p.c. Deb. .	94–96	..	4 3 4
851,070	10	Oct. 12	7	River Plate Ord. . . .	12¼–12⅝	..	5 7 8
300,000	Stk.	Dec. 28	4	Do. 4 p.c. Deb. .	95–97	..	4 2 6
250,000	10	Sept. 27	8	San Paulo, Ltd. . . .	13¾–13⅞	..	5 16 5
70,000	50	Jan. 2	5	Do. 5 p.c. Deb. .	48–50	..	5 0 0
135,000	Stk.	Sept. 13	10	Sheffield A	248–250	..	4 0 0
209,984	,,	,,	10	Do. B	248–250	..	4 0 0
523,500	,,	,,	10	Do. C	248–250	..	4 0 0
70,000	10	Oct. 26	10	South African	15½–16½	..	6 1 3
6,350,000	Stk.	Aug. 15	5½	South Met., 4 p.c. Ord.	128–130	..	4 4 7
1,895,445	,,	Jan. 16	3	Do. 3 p.c. Deb.	84–8.*	..	3 9 9
201,720	Stk	Sept. 13	8	South Shields Con. Stk.	158–163	+2	5 0 0
575,000	Stk.	Aug. 15	5½	S'th Suburb'n Ord. 5 p.c.	123–126	..	4 7 4
60,000	,,	,,	5	Do. 5 p.c. Pref. . .	123–126	..	3 19 4
112,533	,,	Jan. 16	5	Do. 5 p.c. Deb. Stk.	125–130*	..	3 16 11
502,310	Stk.	Nov. 14	5	Southampton Ord. . .	107–112	+2	4 9 3
120,000	Stk.	Aug. 30	6½	Tottenham } A 5 p.c. . and } B 3½ p.c. .	127–130	..	5 0 0
388,020	,,	,,	5		104–106	..	4 14 4
137,500	,,	Dec. 28	4	Edmonton } 4 p.c. Deb.	101–103	..	3 17 8
182,380	10	,,	8	Tuscan, Ltd.	10½–11	..	7 5 6
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	102–104	..	4 16 2
193,742	Stk.	Sept. 13	5	Tynemouth 5 p.c. max.	106–108	..	4 12 7
30,000	Stk.	Aug. 15	8	Wands-worth and } A 5 p.c. . B 3½ p.c. . C 3½ p.c. .	140–145	..	—
255,636	,,	,,	6½		104–145	..	4 9 8
75,000	,,	,,	5⅝		113–115	..	4 17 6
79,416	,,	Dec. 28	3	Putney } 3 p.c. Deb. Stk	79–82	..	3 13 2
279,875	,,	Aug. 15	5½	West Ham 5 p.c. Ord. .	104–107	+1½	4 15 9
185,000	,,	,,	5	Do. 5 p.c. Pref. . .	120–123	..	4 1 4
193,300	,,	Dec. 28	4	Do. 4 p.c. Deb. Stk.	102–105	..	3 16 2

Prices marked * are "Ex div."

in which he stated that, by request of the Inspector, he had attended at Kirkcaldy on the 26th of September, and on the 3rd and 16th of October, and tested sundry electric lights and incandescent and flat-flame gas-lights, as used throughout the town. . . . He found that the electric lights gave an average light of 670·9 candles. The electric incandescent burners gave a light of 12·3 candles. The gas-lamps he tested in various parts of the town, and found that the best results were obtained from the 2-feet Kern burner used in the new pattern lantern, which gave an average of 40·5-candle power, or 20·25 candles per foot of gas consumed. The 2½ cubic feet "C" burner varied considerably, according to the lantern used; the average being 32-candle power, or 12·8 candles per cubic foot of gas consumed—the difference of a good lantern influencing the light some 30 per cent. The 3 feet "C" burner gave an average light of 37·9-candle power, or 12·63 candles per cubic foot of gas consumed. These results pointed to the advantage of using a good lantern, with reflectors at correct angles, with the best type of burner. The flat-flame burners tested gave a light of 9·44-candle power, or 4·72 candles per cubic foot of gas consumed. He also tested a Lucas lamp outside the Gas Company's office, which he understood consumed 24 cubic feet of gas per hour. The lamp gave a light of 780-candle power, or 32·5 candles per cubic foot of gas consumed. As a comparison of the cost of the electric arc lights and the high-power Lucas gas-lamps, it might be mentioned that the former cost £12 per annum for (say) 1277 hours of burning of one arc lamp till 11 p.m., and two incandescent electric lamps for the rest of the time. For a Lucas lamp lighted until 11 p.m., and two 2-feet Kern burners the rest of the night, the cost would be £4 16s. 8d. with gas at 2s. 5d. per 1000 cubic feet. This price was for a practically equal light to 11 p.m., and for six or seven times the light for the rest of the night. The electric arc lamps showed an average cost per candle power per annum of 4·25d. The aim of street lighting should be as near an approach to sunlight as possible—an even illumination all over the roadway—and not to have brilliantly lighted spaces alternating with dark ones. With the electric lights giving a high candle power near the lanterns, the intervening spaces were comparatively dark; while with the smaller gas-lamps, put at much closer distances, the light was more general and better diffused. As regarded the light derived from the incandescent electric lights, little need be said, as they only gave a small amount of light, and that at such a distance apart that no even illumination of the streets need be looked for. Mr. Allison, in moving that the reports should be remitted to a Special Committee for investigation, said that the 29 miles of streets which were lighted by gas cost, with all oncosts, £3228; while the 4½ miles which were lighted by electricity cost £1248. If the whole of the streets in the burgh were lighted by gas, the cost would be £3741, or £501 for the 4½ miles at present lighted by electricity. This made a waste of £746 on the 4½ miles. Mr. Gourlay considered the report a very startling one, and he thought they would be scarcely justified in continuing the electric light, if it were to cost so much more than gas and not light the streets so well. After discussion, it was agreed to remit the reports to the Lighting and Electric Lighting Committees, the understanding being that the Electrical Engineer might have some reply to make to them.

Some time ago the gas-works in Ecclefechan—a village of about 800 inhabitants—were closed, and since then there has been no public illuminant in the place, to the inconvenience of the community. This state of matters is in course of being remedied. Mr. E. J. Brook, of Hoddom, has purchased the gas-works, and has given an order to Messrs. Spencer and Co., of Stratford-on-Avon, to fit up a De Laitte petrol gas plant in duplicate, of sufficient power to light every building, public and private, in the village. Mr. Brook does not seek to make profit out of the undertaking, and has announced that he will sell gas for all purposes at 2s. 6d. per 1000 cubic feet, with meter-rents, the minimum of which is to be 2s. 6d. a year. The new lighting scheme is being largely supported, many applications for connections having been already received.

The Douglas Gas Lighting Company have presented to the Upper Ward District Committee of the Lanark County Council an account for £28, in respect of damage caused to gas-pipes by the use of the road-roller. The Council have resolved to deny liability; but they have instructed their Surveyor that, in future, when rolling Douglas streets, he is to refrain from working where danger of breaking water or other pipes might be anticipated.

Proposed New Gasholder for Shoeburyness.

The Shoeburyness Urban District Council having applied to the Local Government Board for sanction to borrow £1700 for a new gasholder, Major J. Stewart attended to hold a local inquiry. The Clerk (Mr. F. Gregson) said the holder had become absolutely necessary in consequence of the increase in the consumption of gas; and the Council had previously accepted the tender of Messrs. S. Cutler and Sons at £1434 for a holder of 60,000 cubic feet capacity. The Council themselves were to lay the foundations, the cost of which was estimated at £100. In addition, the expenses of the loan were put down at £20, and contingencies (10 per cent.) at £146, making £1700. He asked that the repayment of the money might be spread over 30 years, or as long a period as possible. The Inspector said he saw by the plans that they had only one small holder; and if anything went wrong, they would be in considerable trouble. The figures he had before him showed that between 1897 to 1900, the consumption of gas nearly trebled. In 1897, the quantity was 1,300,000 cubic feet; in 1898, 1,800,000 feet; in 1899, 2,700,000 feet; and in 1901, 3,100,000 feet. Mr. Gregson said he should think that this quantity had doubled by now; but he could not say for certain off-hand. Subsequently, Messrs. Cutler were communicated with; but they stated that, as prices had gone up since the tender was sent in, they would have to increase the amount. Thereupon the Council, on the motion of Mr. Neil (who pointed out that as the winter was now nearly over, the erection of the holder could be deferred), it was agreed that the question should stand over for two months. The Council thanked Messrs. Cutler for their trouble.

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CURRENT SALES OF GAS PRODUCTS.

Week ending Jan. 26.

The London market for tar products is still in an improving condition. With regard to pitch, stocks are at the present time abnormally low, in consequence of heavy shipments; while 1s. 6d. to 2s. per ton more than the late low prices has recently been paid. London makers are very full with orders for some time to come. There is more inquiry for 60's crude carbolic acid; and 1s. 9d. net is asked for a limited quantity. Benzol 90 per cent. is firm at 1s. to 1s. 0½d. net. It is reported that a large business has been done in ordinary London creosote oil at 2½d. net in bulk at makers' works. Sulphate of ammonia is also in an improving position; the closing price being £12 5s. on Beckton terms for February delivery.

LIVERPOOL, *Jan.* 26.

Sulphate of Ammonia.

The week opened with good demand, available parcels being readily picked up at hardening prices. Later, however, buyers were less keen; and the market closes quietly at £11 15s. per ton f.o.b. Hull, and at £11 18s. 9d. per ton f.o.b. Liverpool. At Leith, the market has been somewhat irregular; and the closing quotations are £12 to £12 2s. 6d. per ton f.o.b. There has been some buying for February delivery at a premium of about 2s. 6d. per ton on spot prices. For March-April delivery there have been sellers at £12 7s. 6d. per ton, but no business thereat has transpired; and Leith, April-September delivery, has been quoted £12 5s. per ton without finding buyers.

Nitrate of Soda.

This article has been firmer in the forward position, and the spot market has been steady at 11s. 3d. per cwt. for 95 per cent., and at 11s. 9d. for refined quality.

LONDON, *Jan.* 26.

Tar Products.

There has been rather more business doing during the past week, and markets have remained generally firm. Pitch is quiet but steady. There are indications that the bottom has been reached for the present, and probably it would no longer be possible to buy at 24s. on the East Coast, though a small quantity might be secured at 24s. 6d. On the other hand, some of the best makers report having been offered 25s. for delivery to June. In Liverpool and Manchester, there does not seem to be very much business doing—makers not seeing their way to accept the values offered by dealers. There is a certain amount of buying going on in South Wales; but consumers in this district do not appear to be at all anxious, and are evidently fairly well covered. On the Continent, they only seem willing to consider business for next season; and for this delivery, they will only entertain offers at to-day's prices. Creosote is very firm, with the exception of prompt London oil, of which there is still some quantity to be placed; but for forward, London manufacturers are very firm indeed, and do not appear at all anxious for business. In the North and Midlands, manufacturers are very well sold, and unable to consider business for February-June to any extent; while for the last six months of the year they refuse to quote. Solvent naphtha was decidedly easier early in the week, and business was done upon the east coast at 1s. 1d. to the end of June. It is now, however, rather firmer, and sales are reported at 1s. 1½d. and 1s. 2d. over the same period. Benzol, 90 per cent., is quiet. Some small quantity could no doubt be obtained for prompt delivery at 1s.; but for forward, makers do not care to quote. In the North, business is reported to have been done at a little over 10d. per gallon at makers' works. Benzol, 50-90 per cent., is steady; but there does not appear to be much anxiety to do business. Sellers refuse to quote prices, and will only consider offers made to them. Carbolic acid is quiet. Some of the English consumers report having covered their present requirements to June, and are now only open to consider low offers. Continental consumers refuse to pay more than 1s. 8½d. on the east coast, and state that they are getting supplies at this figure. In crystals, there is no alteration, and business continues to be done at market prices. Toluol is steady, and fairly well sold. Not many parcels are offering, but those that are command good figures. Sales of tar continue to be reported at very low figures, both for prompt delivery and upon contract.

The average values during the week were: Tar, 13s. to 17s. Pitch, London, 24s. 9d. to 25s.; east coast, 24s. 6d. to 25s.; west coast, 23s. 6d. to 24s. 6d. Benzol, 90 per cent., 11d. to 11¾d.; 50-90 per cent., 11½d. to 1s. Toluol, 1s. 1½d. to 1s. 2d. Crude naphtha, 4¾d. to 5d.; solvent naphtha, 1s. 1d. to 1s. 3d.; heavy naphtha, 1s. 2d. to 1s. 4d. Creosote, London, 2d. to 2¼d.; North, 2d. to 2⅛d. Heavy oils, 2¼d. to 2⅝d. Carbolic acid, 60 per cent., 1s. 8½d. to 1s. 8¾d. Naphthalene, £5 to £9; salts, 34s. to 37s. 6d. Anthracene, "A" quality, 1½d. to 1⅝d.

Sulphate of Ammonia.

The market for this article has been steady during the past week, and prices have certainly improved somewhat. There is no alteration in the quotations of the principal London Gas Companies; but the very wide margin which existed previously between them and other London makers no longer exists, though second-hand parcels are reported to have been sold in London for immediate delivery at low figures. In Hull, fine makes have been sold at £12. The same figure has been paid for February-March, and makers prefer now to await the course of events before selling any further quantity. In Liverpool, business is reported to have been done at £12; while even higher figures have been offered for forward delivery without success. In Leith, dealers have offered £12. These prices, however, makers have refused to consider; they being well sold, and not at all anxious for any further business this side of March.

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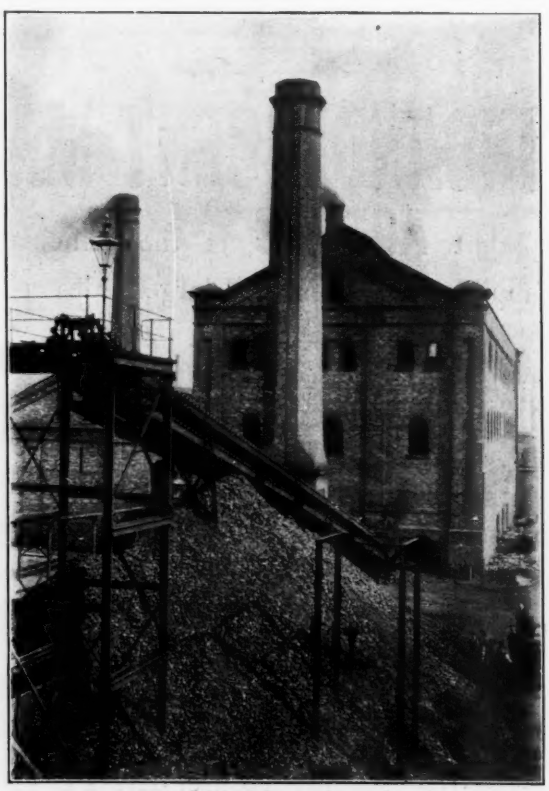

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COAL TRADE REPORTS.

Lancashire Coal Trade.

As was pointed out last week, there is every probability of still higher prices being charged for coal and cannel for gas manufacture, as well as for engine fuel and coal for domestic purposes. The sudden descent of a frosty temperature has given an impetus to sales in most directions; and more coal is wanted for shipping. Meetings have been held in the North, in Yorkshire, and in London to consider the advisability of making advances; and in some districts, the price of all grades of manufacturing and engine fuel and slack has been raised 1s. per ton. In Lancashire, no decided united action has yet been taken; but it is not unlikely that a meeting of coalowners may be held to-day in Manchester, to consider what steps, if any, shall be taken. In the meantime, last week's quotations may be relied upon to hold good to the end of the present month. Yesterday, the price of coke for household consumption was raised from 5s. 10d. to 7s. 6d. per ton. In another fortnight, the price will be again increased.

Northern Coal Trade.

There is continued activity in the coal trade of the North-east; and the tendency in prices has been towards further advances, so that the quotations are higher than for some time. In the steam coal trade, there is a demand that is unusually full for this season of the year. For best Northumbrian steam coals 13s. 6d. and up to 14s. per ton f.o.b. are the quotations. Second-class steams are 12s. 6d. to 13s. per ton, and steam smalls are steady at from 7s. 6d. to 8s. 6d. The collieries are now working regularly, and the normal output seems to be well taken up. In the gas coal trade, there is less pressure in the demand. It is, however, full, and there is still some scarcity of best Durham gas coals. Deliveries are heavy on the long contracts, and prices are very well sustained for all qualities. Quotations are from about 11s. to 12s. 6d. per ton f.o.b., according to quality, &c., and up to 13s. is quoted in cases where collieries have a large part of their output well sold forward. There is nothing new as to contracts this week; but a large Swedish one must be soon in the market. Coke is very firm; and gas coke shows little change—the current price for good gas coke varying from about 13s. to 13s. 9d. per ton f.o.b.

Scotch Coal Trade.

Trade has been strong during the week. Ell is in great demand for shipment, and very scarce for prompt delivery. Splint is firm. A large volume of business is being done. The prices quoted are: Ell 11s. 3d. to 12s. 6d. per ton f.o.b. Glasgow, splint 12s. to 12s. 6d., and steam 10s. 6d. to 10s. 9d. The shipments for the week amounted to 254,888 tons—an increase of 74,027 tons upon the preceding week, and of 28,475 tons upon the same week of last year. For the year to date, the total shipments have amounted to 524,076 tons—a decrease of 6825 tons upon the corresponding period.

The Price of Gas Coal.

Writing on the subject of the price of gas coal, the "Iron and Steel Trades Journal" says that an important step is being taken by the owners of gas-coal pits in the Midlands, working in combination, to considerably raise the market price of gas fuel. The object is to secure a share of the revenue now finding its way into the pockets of the gas shareholders; the colliery owners having for some time "looked with an envious eye" on a proportion of this profit. It is hoped that fully 2s. 6d. per ton advance will be secured when the contracts for 1907-8 delivery come to be made; and it is stated that members of the proposed Association of colliery owners shall not go on supplying works over contract quantities except at an advance of 1s. per ton up to June next. Some fear is expressed, however, that the non-adherence of one or two large firms famous for underselling may stand in the way of a satisfactory agreement. The first move in the direction of an Association has been forced on the colliery owners by the miners' leaders, who have plainly intimated to owners that, unless the price of gas coal was considerably advanced—that is, to rates which would bring up the average selling price to a figure which would show in their favour, in case they wished at any time to apply for an advance in wages—they would bring the men out on the question.

Price of Gas in New York.—We learn from "Progressive Age" that the Appellate Division has affirmed a decision of the Supreme Court of New York, refusing to grant to Mr. Dinkelspiel, a consumer of the Consolidated Gas Company, a *mandamus* directing the Company to supply him with gas at 80 c. per 1000 cubic feet. Justice Bischoff based his refusal on the ground that there was an issue of fact raised between the parties concerning the production cost of gas, and that where such an issue is raised a *mandamus* will not be granted on mere affidavits, but only where necessary after a trial. A large number of similar applications were dependent on this case, and the action of the Appellate Division in affirming the decision is considered a victory by Counsel for the Company.

New Joint-Stock Companies.—The Tenterden Gas Company, Limited, has been registered with a capital of £2400, in £10 shares, for the supply of gas in Tenterden. The Company was originally constituted by Deed of Settlement dated Aug. 31, 1838; and the undertaking has been governed by this and various supplementary deeds. The Waste Heat and Gas Electrical Generating Stations, Limited, has been registered with a capital of £100,000, in £1 shares, to generate, store, transmit, purchase, supply, and distribute electrical and other energy for motive power, light, heat, or other purposes, and to utilize and deal in the waste products of, and gases and waste heat from, any works, coke-ovens, furnaces, or factories, &c. The Ramie Wool and Flock Mills Company, Limited, has been registered with a capital of £64,000, in £1 shares, to acquire the Unsted Mills, Shalford, Surrey, and a secret process relating to the treatment of ramie, &c., and also to adopt an agreement with Mr. L. H. Raw.

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Proposed Duplication of the Plymouth Water-Main.

At their meeting last week, the Water Committee of the Plymouth Corporation had under consideration a proposal to duplicate the main-pipe through which the town is supplied with water. About fifteen years ago, a pipe was laid as a substitute for the open leat by means of which the town had been supplied up to that time. The water flows from the storage reservoir at Burrator, on Dartmoor, to Roborough, about six miles from the town, where there is a service reservoir. From this point onward, the main is drawn upon for supplies *en route*, and complaint has been made that at Crown Hill, three miles from Plymouth, where there are large military barracks, the pressure is inadequate. This circumstance, coupled with the fact that owing to the increase of population the demand is continually growing, led the Committee to the conclusion that a second main is desirable. It was therefore decided to include in the estimates of capital expenditure for next year a sum of £15,500 for this purpose. As an alternative to the scheme, it was suggested that a small pipe should be laid from Roborough to Crown Hill, so as to give the latter place a constant supply. The Committee, however, came to the conclusion that a second main of large dimensions is desirable, in order to safeguard Plymouth against the discontinuance of the supply through any accident to the existing main. Some years ago £14,500 was borrowed for the purpose ; but the money has not been utilized for the water-works, though the undertaking has been charged with the interest and sinking fund upon it. If the Corporation approve of the proposal to proceed with the scheme now, the remainder of the money required will be borrowed.

Water-Works Transfer at Skelmersdale.

A meeting of the property-owners and ratepayers of Skelmersdale, convened by the Urban District Council, was held at the Town Hall on Monday last week, to consider the terms of an agreement, dated Aug. 21, 1906, whereby the Council had undertaken to transfer their water-works in the township of Lathom to the Southport, Birkdale, and West Lancashire Water Board. The Chairman of the Council (Mr. John Pearce), who presided, explained that the Council were not selling the mains in Skelmersdale, but the works and mains outside and up to the boundary of the township. During the last seven or eight years, the constantly decreasing supply of water at the Scarth Hill well had been a source of anxiety to the Council. Not only so, but the water area had been encroached upon considerably by the sinking of other wells in the neighbourhood. The climax had come when the Water Board sought to promote a Bill which provided for the sinking of a well in Bickerstaffe, at a distance not greater than two miles from the Council's well at Scarth Hill. The Council then proceeded to safeguard this well, and obtained a protective clause, which had cost £538. With a district of which the assessable and rateable value was constantly decreasing, and with a rate of 3s. 6d. in the pound, they thought that, instead of expending upwards of £1000 in making alterations to the well, and another £600 in opposing the Bill, it would be wise to enter into negotiations for the sale of their water undertaking at Scarth Hill. But they had assured the safety of the Skelmersdale water supply. By a clause in the Bill, Skelmersdale was to be provided with water in perpetuity. It would have the first claim upon the water from the Scarth Hill well, and their supply would be safeguarded to the extent of 75 million gallons, whereas the consumption in the highest year had never exceeded 45 millions. The Council had agreed to accept £22,500 for their water undertaking. By this transaction, they hoped to be able to reduce the rates by 11d. in the pound. A resolution approving of the transfer was carried unanimously.

The Debt of London.

The Statistical Officer of the London County Council (Mr. E. J. Harper) has prepared a return, under the direction of the Finance Committee, relating to the debt of the various London Local Authorities—showing for each Metropolitan Borough and Poor Law Union the debt outstanding on March 31, 1906, and the annual charge on the rates in 1905-6 in respect of such debt, together with an analysis of the total debt of London according to the nature of the services for which loans have been raised. The return shows that the total net debt of London on March 31, 1906, secured upon the rates was £105,602,301, of which £50,902,464, or 48 per cent., was in respect of water supply, tramways, workmen's dwellings, electric lighting, and certain other revenue-producing services, the debt charges in respect of which are for the most part met out of the receipts from such services. The total charge in 1905-6 for interest and repayment in respect of the total net debt amounted to £5,637,502, of which £3,883,446 was met out of the rates, and the balance of £1,754,056, or 31·3 per cent., out of the receipts from revenue-producing services. The total net debt, excluding London's proportion (£38,575,517) of the debt (£47,393,371) of the Metropolitan Water Board, increased during the year 1905-6 by £1,238,763, or 1·9 per cent., as compared with an increase of £4,521,691, or 7·4 per cent., the previous year. This increase is the smallest for eight years ; the average annual increase since 1896-7 being £3,372,000. It is, moreover, entirely due to the increase of debt upon revenue-producing services ; the debt in respect of other services showing a net decrease of £240,000. The responsibility for the increase of the net debt is divided as follows : London County Council (including education), £613,933 ; Metropolitan Borough Councils, £851,818 ; other bodies (decrease), £226,988. The increase in London's proportion of the debt of the Metropolitan Water Board, excluded from the above figures, was £1,098,995, representing an increase of 2·93 per cent. The percentage of the total net debt to rateable value increased in the year from 254·37 to 256·80. The total charge on the rates increased by £1038, or 0·03 per cent., compared with an increase of £240,022, or 6·6 per cent., the previous year. The equivalent average rate in the pound has decreased from 1s. 10·90d. to 1s. 10·59d.—*i.e.*, by 0·31d. in the pound.

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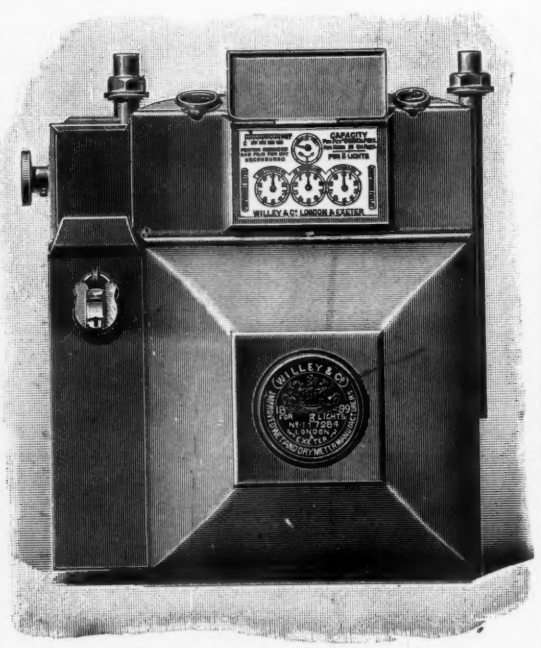

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AGENTS FOR SOOTLAND:

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The Jamaica Earthquake.—Recent advices from Kingston are to the effect that the gas-works have been practically annihilated by the recent earthquake; and it is feared that illumination by gas will be impossible for the next six months. Water, however, is plentiful; and people are returning to the few habitable houses.

The Explosion at the Dublin Gas-Works.—A second death has unhappily occurred as the result of the explosion which took place at the gas-works in Great Brunswick Street, Dublin, on the 10th inst. Michael M'Donagh, whose condition was all along regarded as very serious, died at the City of Dublin Hospital last Sunday week.

Colne Valley Water Bill.—It is stated that the Hendon Rural District Council have decided to oppose the Bill which the Colne Valley Water Company are promoting to give them power to increase their capital. Besides this body, other local authorities will also oppose the Bill, as now that the Company have reached their maximum dividend, it is thought the ratepayers should enjoy the benefit of a lower water-rate—which they fear is not likely to be the case if the Company are allowed to extend their capital and incur fresh liabilities.

Totnes Water Supply.—A scheme for increasing the water supply was approved by the Totnes Town Council last Tuesday. Under the agreement, the Corporation are to have the right of taking a supply of water from Follaton to supplement the existing supply. It was stated that the undertaking is in a very flourishing condition. Last year the profit was £200; and it might have been more, had it been possible to give a supply to certain consumers. The cost of the new supply is estimated at from £130 to £150 a year; but it is thought that the additional revenue will cover this.

Coventry Water Scheme.—An interesting point has now arisen in connection with the arrangement that the Coventry Corporation have entered into with Birmingham for the supply of water from the latter's Shustoke reservoir. The suggestion is being put forward that the villages between Birmingham and Coventry through which the pipe is to be laid should be allowed to take a supply. Coventry will, of course, oppose this idea; but Birmingham may be open to make some arrangement. It is stated that the Warwickshire County Council have expressed the opinion that the villages in question should be enabled to take a supply; but nothing has yet been settled.

Devonport Water Company.—The last stage in the history of the Devonport Water Company was reached on Thursday, when a meeting of the stockholders was held to adopt the final account of the Liquidators, who are the Directors of the Company. Mr. Foster J. Bone, the Secretary, presented the accounts, which were adopted. A resolution was passed authorizing Mr. Samuel Wood, the Accountant who settled the scheme for the distribution of the purchase-money and assets, to determine how the balance in the hands of the Liquidators shall be allotted among the stockholders and the Directors and officers. Mr. Bone was instructed to send to Mr. Wood a list of the Directors and officers, with particulars of their service, &c.

Lectures on Gas-Meters in Belfast.—Mr. C. P. Knight (representative in Ireland of Messrs. Parkinson and W. & B. Cowan, Limited) recently delivered two most successful lectures, on gas-meters, to the students of the "Gas Distribution" class at the Municipal Technical Institute, Belfast. The lecturer illustrated his remarks by exhibiting, upon each occasion, beautiful working models of various meters; also an interesting selection of optical lantern slides. The valuable instruction and practical demonstrations were highly appreciated by those present. In response to urgent requests, Mr. Knight has consented to lecture on gas-meters before a larger audience on the 28th prox., under the auspices of the Belfast Gas Department Technical Guild.

Paris Water Supply.—It is not a little curious that while the Municipal Council of Paris are occupied with the question of the gas supply of the city, that of the supply of water should also be before them. Though the city own the whole of the water-works, they are actually operated by a concessionary Company, who are now applying for a renewal of their concession for 25 years. The Prefect of the Seine, who has reported upon the subject, advises that the application should be granted, as he considers it would cost the Municipality about £20,000 a year more to carry on the work themselves than to have it performed by the Company. The gross receipts of £880,000 a year are earned at an estimated cost of £44,800 a year, whereas, according to the Prefect, it would cost the municipal authorities not less than £64,000 per annum to arrange for the distribution themselves.

Gas Suffocation Case in London.—Last Wednesday, an inquest was held at the Marylebone Coroner's Court on the body of Miss Howard, an actress, who was on Monday morning found dead in her New Cavendish Street flat. The evidence showed that she was suffocated by gas which was escaping from a stove. A servant in the deceased's employ said she found on examination that the screw-tap had not been properly screwed up. The tap was very loose; and it was possible that, in attempting to screw it up, one might not do so properly. A year ago she found her mistress in an insensible condition; and on that occasion the gas-stove, which had been turned on, had not been lighted. It was, however, stated by a friend who was with Miss Howard the evening before her death that she was then in high spirits; and the Jury returned a verdict of "Death by misadventure."

Penrith Water Scheme.—The ratepayers of Penrith, in public meeting, have almost unanimously approved of the proposal of the Urban District Council to spend about £48,000 on a water scheme, to bring a supply from Hayeswater Tarn, on the hills between High Street and Grey Cragg. The principal objections raised were that the figures placed before the ratepayers now and in connection with a former gravitation scheme displayed serious discrepancies. This the Clerk denied; asserting that the changed conditions alone accounted for the differences. It was also stated that the draft agreement with the Earl of Lonsdale's Trustees provided for an inclusive payment for all rights and works, as well as the taking of 750,000 gallons a day—as much as a 9-inch main would carry. The water question has been under discussion for nearly seventeen years; and it is stated that no previous scheme has had the least chance of securing unanimity.

THE "BLAND" LIGHT IN CHURCH.

ACTUAL FACTS

ST MARY'S HOUSE.
ROSS.

4th Jany 1907

Dear Sirs

I have to day received from the Ross Gas Co. the amount of Gas Consumed in Ross Church during Xmas Quarter 1906.

The Success of the Bland Burner has exceeded my Expectations.

The Saving on this Quarter alone has been 33.400 ft. & the value of £6. 13. 7.

Ross Xmas Qr. 1905
Naked Burners 65. 200

Xmas Qr. 1906
Bland Light 31. 800

33. 400.

During the Whole of this Quarter we have not renewed a single mantle or globe.

Yours faithfully
W. Watson

Churchwarden Ross Parish Church

For full details respecting the "Bland" Light for
CHURCH, FACTORY, SHOP, & DOMESTIC LIGHTING,
WRITE TO—
BLAND & CO., 63, Queen Victoria St., London, E.C.

Owing, it is supposed, to the severe weather, the lighting of Lausanne failed last Thursday, and the town was left in darkness.

The tender of Messrs. Thomas Cash, Son, and Co., of Birmingham, has been accepted for the supply to the Nottingham Corporation Gas Department of 15,000 tons of cannel over the current year.

Messrs. John Wright and Co. send a list of some fifteen important places in and around Glasgow where their gas-heated steam radiators have recently been installed, and which they say is "but about a quarter of the full list."

The left bank of the Seine was put in darkness for three hours last Tuesday by an accident at the electric light works, and the business at the Senate, Courts of Justice, and Prefecture of Police had to be carried on by the aid of lamps and candles.

Messrs. Joseph Taylor and Co. have received from the Bodmin Gas Consumers' Company, Limited, and the Carlow Gas Company orders for their best makes of solid-plate lead saturators, in both cases guaranteed for a period of six years against all leakages; also further orders from Messrs. William Butler and Co., Limited, of Bristol, comprising lead pipes and bends for their Gloucester works, in connection with the waste gases and ammonia, and also for a sulphate drainer.

An application has been made to the Local Government Board by the Cowes Urban District Council to borrow £970 for works connected with a new main, with a view to improving the supply of water to the highest levels of the town—making it continuous instead of intermittent. The arguments at the public inquiry before Lieut.-Col. H. E. Smith were chiefly against the expense for so comparatively small a district; while as to the alleged continuous supply, doubts were thrown upon this idea—the town having previously heard of schemes of this character which had never been carried through.

In the last number of the "JOURNAL," reference was made to a lecture on "Coal and its Bye-Products," recently delivered at the Stockton Literary and Scientific Institute by Mr. Dunn, the Assistant-Manager of the gas-works. It was one of several which he has been giving in the town, and we learn that the audiences have always been large. A gratifying feature about the lectures is that the proceeds of practically all of them are devoted to the Stockton Hospital Extension Fund.

At the annual tea and concert of the Scarborough gas workers, Mr. A. Allan, the Manager, who presided, pointed out that distress in the town was very acute; and he suggested that those present—whose work was constant—should contribute to the unemployed fund. Speaking of the gas industry, Mr. Allan remarked that he was glad Scarborough was sharing in the general progress. Their increase during the past year had been a very good one; and the fact that an increase took place in the summer months indicated that the season had been successful, for the consumption of gas might be taken as a good pulse.

In the course of a paper, entitled "Gas Superior to Electricity for Lighting Purposes," read before the Newcastle Y.M.C.A. Chamber of Commerce, Mr. E. A. Robson said that gas gave an increased candle power as compared with electricity, which reduced the price to the extent of as ten to one. It also gave a more diffusive light, making it less harmful to the eyes. Gas was more adaptable for general outdoor and indoor illumination; and better ventilation was secured, because the heat which was generated caused a motion of the air, which reduced the risk of infection in crowded rooms. There was much less risk of fire, because gas required a naked light before it would burn, whereas with electricity various circumstances might lead to a conflagration. There was, further, a greater reliability of supply with gas, because there was no risk of stoppages due to a breakdown at the works.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

REPRESENTATIVE (Coal). No. 4694.
OFFICE MANAGER AND REPRESENTATIVE. No. 4707.
WORKS FOREMAN. No. 4705. Applications by Jan. 30
INSTRUCTION IN COOKING, &c (LADY). No. 4706.
FITTER, &c. No. 4708.

Situation Wanted.

SHOW-ROOM ATTENDANT, &c. No. 4709.

Stocks and Shares.

SUNDERLAND AND SOUTH SHIELDS WATER COMPANY. Feb. 21.

Company Meetings.

COMMERCIAL GAS COMPANY. Cannon Street Hotel. Feb. 14. Twelve o'clock.
SOUTH SUBURBAN GAS COMPANY. Albion Tavern. Feb. 22. Three o'clock.

TENDERS FOR

Boiler.

CONGLETON GAS DEPARTMENT. Tenders by Feb. 9.

Coal.

MILFORD HAVEN GAS AND WATER DEPARTMENT. Tenders by Feb. 11.

Fire-Clay Goods.

TODMORDEN GAS DEPARTMENT.

Governors.

CONGLETON GAS DEPARTMENT. Tenders by Feb. 9.

Iron and Steel Work, &c.

COVENTRY GAS DEPARTMENT. Tenders by Feb. 18.

Meter (Station).

CONGLETON GAS DEPARTMENT. Tenders by Feb. 9.

Pipes and Specials.

RADCLIFFE AND PILKINGTON GAS COMPANY. Tenders by Feb. 5.
CONGLETON GAS DEPARTMENT. Tenders by Feb. 9.

Purifiers and Roof.

CONGLETON GAS DEPARTMENT. Tenders by Feb. 9.

Retort Setting.

TODMORDEN GAS DEPARTMENT.

Valves.

CONGLETON GAS DEPARTMENT. Tenders by Feb. 9.

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Resists 4500° Fahr. Best for GAS-WORKS.
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